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NATIONAL DAM SAFETY PROGRAM. CAMPBELLS POND DAM (NJ00517), RAHW--ETC(U)
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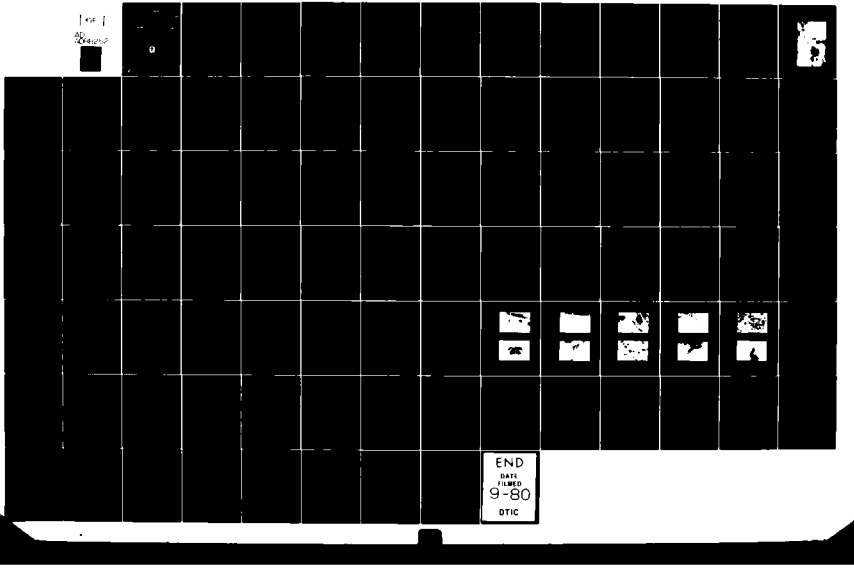

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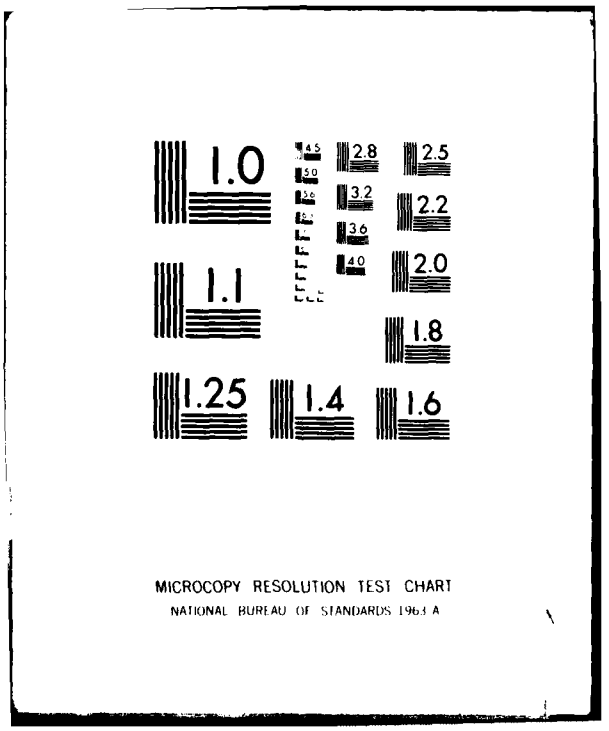
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NEW JERSEY

CAMPBELLS POND DAM

NJ 00517

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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JANUARY 1980

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(1) Richard McDermott

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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National Dam Safety Program.
Campbells Pond Dam (NJ00517), Rahway River Basin, West Branch
~~Essex County, N.J.~~ Rahway River, Essex County, New Jersey
Phase I Inspection Report

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Dams	National Dam Safety Program
Embankments	Campbell's Pond Dam, New Jersey
Visual Inspection	Spillways
Structural Analysis	Seepage

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-N

11 AUG 1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Campbells Pond Dam in Essex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Campbells Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate because a flow equivalent to 85 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from date of approval of this report, the following engineering studies and analyses should be initiated:

(1) If it exists, the outlet works should be investigated and restored to a functional condition. If no outlet works exists, an adequate low level lake drain should be designed and installed.

(2) The masonry portion of the dam should be thoroughly inspected by a professional consultant engaged by the owner. The dam should be inspected with the lake drawn down and with the lake filled. Based on the inspections,

together with any necessary subsoil, seepage and structural investigations, remedial measures to correct the leakage and other possible causes of distress should be determined then implemented.

c. Within six months from the date of approval of this report, the following remedial action should be completed:

(1) All trees and bushes on the embankment should be removed.

(2) Debris in the downstream channel should be removed.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

e. The owner should develop an emergency action plan outlining actions to be taken by the operator to minimize the downstream effects of an emergency and establish a flood warning system for the downstream communities within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Minish of the Eleventh District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-N

Honorable Brendan T. Byrne

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

CAMPBELLS POND DAM (NJ00517)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 15 November and 23 November 1979 by Storch Engineers under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Campbells Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate because a flow equivalent to 85 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

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(1) All trees and bushes on the embankment should be removed.

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e. The owner should develop an emergency action plan outlining actions to be taken by the operator to minimize the downstream effects of an emergency and establish a flood warning system for the downstream communities within six months from the date of approval of this report.

APPROVED: _____
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 18 July 80

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Campbells Pond Dam, NJ00517
State Located:	New Jersey
County Located:	Essex
Drainage Basin:	Rahway River
Stream:	West Branch Rahway River
Dates of Inspection:	November 15, 1979
	November 23, 1979

Assessment of General Condition of Dam

Based on visual inspection, past operational performance and Phase I engineering analyses, Campbells Pond Dam is assessed as being in poor overall condition.

Based on investigations of the downstream flood plain made in connection with this report, it is recommended that the hazard potential classification be downgraded from high to significant hazard.

Hydraulic and hydrologic analyses indicate that the spillway is inadequate. Discharge capacity of the spillway is not sufficient to pass the designated spillway design flood (SDF) without an overtopping of the dam. (The SDF for Campbells Pond Dam is equal to one-half the probable maximum flood.) The spillway is capable of passing approximately 42 percent of the probable maximum flood or 84 percent of the SDF. Therefore, the owner should engage a professional engineer experienced in the design and construction of dams in the near future to perform accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of the analyses, the need for and type of remedial measures should be determined and then implemented.

Extensive leakage and other indications of possible distress in the dam were observed. Therefore, the masonry portion of the dam should be thoroughly inspected in the near future by a professional engineer experienced in the design and construction of dams. The dam should be inspected with the lake drawn down and also with the lake filled. Based on the inspections, together with any necessary subsoil, seepage and structural investigations, remedial measures to correct the leakage and other possible causes of distress should be determined and then implemented.

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future:

1) If it exists, the outlet works should be investigated and restored to a functional condition. If no outlet works exists, an adequate low level lake drain should be designed and installed.

2) All adverse vegetation on the embankments should be removed.

3) Debris in the downstream channel should be removed.

The owner of the dam should initiate, in the near future, a program of periodic inspection and maintenance, the complete records of which to be kept on file and made available to the public. A visual inspection of the dam and appurtenances by a professional engineer experienced in the design and construction of dams should be made annually and reported on a standardized check-list form. Repairs should be made as required and the following maintenance should be performed annually: remove trees and brush from the embankments, fill and sod any eroded surfaces of the embankments and clear the downstream channel. After the outlet works have been made operative or installed, at least once

Extensive leakage and other indications of possible distress in the dam were observed. Therefore, the masonry portion of the dam should be thoroughly inspected in the near future by a professional engineer experienced in the design and construction of dams. The dam should be inspected with the lake drawn down and also with the lake filled. Based on the inspections, together with any necessary subsoil, seepage and structural investigations, remedial measures to correct the leakage and other possible causes of distress should be determined and then implemented.

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future:

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2) All adverse vegetation on the embankments should be removed.

3) Debris in the downstream channel should be removed.

In the near future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

Richard J. McDermott, P.E.

John E. Gribbin, P.E.

OVERVIEW - CAMPBELLS POND DAM

29 NOVEMBER 1979

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 30214. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CAMPBELLS POND DAM, I.D. NJ00517

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspections of Campbells Pond Dam were made on November 15 and November 23, 1979. The purpose of the inspections was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description of Dam and Appurtenances

Campbells Pond Dam consists of a stone masonry free overflow spillway with earth embankments abutting each end. Reportedly, the dam does not include a low level outlet works. Three cast iron pipes penetrating the spillway are reportedly associated with water supply to the City of Orange. Two of these are abandoned while one may be currently in use.

A timber and steel bridge spans the entire length of the spillway and is supported by masonry abutments and piers.

At the junction between spillway and earth embankments, masonry training walls extend upstream and downstream from the spillway. Upstream from the spillway the training walls are located along a portion of the upstream faces of the embankments.

The spillway which is oriented approximately east/west has an overall length of 140 feet and a crest length of 124 feet. The overall length of the dam, including spillway and embankments is 300 feet. The hydraulic height of the dam is 18.5 feet while the structural height is estimated to be 22 feet.

b. Location

Campbells Pond Dam is located in the South Mountain Reservation in the Township of Millburn, Essex County, New Jersey. Constructed across the West Branch of the Rahway River, the dam impounds Campbells Pond. Principal access to the dam is by Brookside Drive which is a paved road located along the lake and downstream channel.

c. Size and Hazard Classification

Size and Hazard Classification criteria presented in "Recommended Guidelines for Safety Inspection of Dams," published by the U.S. Army Corps of Engineers are as follows:

SIZE CLASSIFICATION

	Impoundment	
	Storage (Ac-ft)	Height (Ft.)
Small	< 1000 and ≥ 50	< 40 and ≥ 25
Intermediate	≥ 1000 and $< 50,000$	≥ 40 and < 100
Large	$\geq 50,000$	≥ 100

HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (no permanent structures for human habitation	Minimal (Undeveloped to to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures	Appreciable (Notable agriculture, industry or structures)
High	More than a small number	Excessive (Extensive community, industry or agriculture)

The following data relating to size and downstream hazard for Campbells Pond Dam have been obtained for this Phase I assessment:

Storage: 62 acre-feet

Height: 18.5 feet

Potential Loss of Life:

Heavily used road (Brookside Drive) is located along the bank of the downstream channel for a distance of approximately 2500 feet. Failure of dam could possibly cause loss of life.

Potential Economic Loss:

A road bridge and an urban area of Millburn is located about 2700 feet downstream from the dam. A masonry dam impounding Diamond Mill Pond is located about 1700 feet downstream from the dam.

Therefore, Campbells Pond Dam is classified as "Small" size and "Significant" hazard potential.

d. Ownership

Campbells Pond Dam is owned and maintained by the City of Orange, 29 North Day Street, Orange, N.J. 07050

e. Purpose of Dam

The purpose of the dam is the impoundment of a recharge basin for nearby wells used for water supply for the City of Orange.

f. Design and Construction History

Campbells Pond Dam reportedly was originally constructed about 1899 in conjunction with a pump house located on the east bank of Campbells Pond. The purpose of the dam, at that time, was the impoundment of a reservoir for direct water supply to the City of Orange. Use of the pump house for water supply has since been discontinued.

g. Normal Operational Procedures

The dam and appurtenances are maintained by the Orange City Water Department. There is no fixed schedule of maintenance; repairs are made as the need arises.

Due to the lack of an outlet works, the lake is not lowered as a normal operational procedure. However, the lake reportedly normally becomes dry during the summer months at which time silt is removed from its bed.

1.3 Pertinent Data

a. Drainage Area	6.4 square miles
b. Discharge at Damsite	
Maximum flood at damsite	Unknown
Outlet works at normal pool elevation	No known outlet
Spillway capacity at top of dam (Elev. 218.5)	3748 c.f.s.

c. Elevation (Feet above MSL)

Top of Dam	Varies: 218.5 to 222.0
Maximum pool-design surcharge	219.1
Normal pool	214.0
Spillway crest	214.0
Stream bed at centerline of dam	200.0
Maximum tailwater	206.0

d. Reservoir

Length of maximum pool	1,300 feet
Length of normal pool	1,100 feet

e. Storage (Acre-feet)

Spillway Crest	21 acre-feet
Design Surcharge	70 acre-feet
Top of dam (Elev. 218.5)	62 acre-feet

f. Reservoir Surface (Acres)

Spillway Crest	4.6 acres
Top of dam (Elev. 218.5)	15 acres
Maximum Pool - design surcharge	16 acres

g. Dam

Type	Masonry/Earthfill
Length	300 feet
Height	18.5 feet

Side Slopes		
Embankments	- Upstream	2 horiz. to 1 vert.
	- Downstream	3 horiz. to 1 vert.
Masonry	- Upstream	1 horiz. to 3 vert.
	- Downstream	1 horiz. to 12 vert.
Zoning		Unknown
Impervious core		Unknown
Cutoff		Unknown
Grout curtain		Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Uncontrolled masonry weir
Length of weir	124 feet
Crest elevation	214.0
Gates	N.A.
Upstream channel	N.A.
Downstream channel	Natural stream

j. Regulating outlets

None known.

SECTION 2: ENGINEERING DATA

2.1 Design

No calculations, reports nor plans pertaining to the design of the dam are available.

2.2 Construction

No data nor reports pertaining to the construction of the dam are available.

2.3 Operation

No records of operation and maintenance of the dam subsequent to construction are available. Records of lake level monitoring are available. Reports of inspections made by the State of New Jersey in 1928 and 1929 are contained in the files of the NJDEP. According to the reports, several leaks were present in the masonry portion of the dam. The leaks were assessed as being of a nature that did not threaten the structural integrity of the dam. Suggestions for remedial measures were withheld pending further investigations.

2.4 Evaluation

a. Availability

Available engineering information is limited to that which is on file at the City Engineer's Office, City of Orange and at the NJDEP. The City of Orange file contains copies of lake level gaging records and maps showing the layout of the pump house and water main distribution. The NJDEP file contains correspondence and inspection reports.

b. Adequacy

Available engineering data pertaining to Campbells Pond Dam is not adequate to be of significant assistance to the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

The validity of engineering data cannot be assessed due to the absence of data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspections of Campbells Pond Dam took place on November 15 and 23, 1979 by members of the staff of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1) The embankments of the dam, appurtenant structures and adjacent areas were examined.
2) Areas of suspected seepage were noted and located.
3) The embankment and appurtenant structures were measured and key elevations determined with the use of a surveyor's level.
4) The embankment, appurtenant structures and adjacent areas were photographed.

b. Spillway

The grouted masonry overflow portion of the dam comprises the spillway. The downstream face of the spillway is generally aligned straight with some displacement of stones at the toe near its center. Also, some stones at the toe have been dislodged. Extensive patching and pointing of the stones on the downstream face is evident. The spillway apron which appeared to be composed of stone masonry overlaid with concrete, was observed to be in deteriorated condition. A timber strip which is located on the downstream face at the crest has a small section broken away near the center.

Extensive leakage was noted discharging from the downstream face. The leaks were numerous and extended across the entire length of the spillway. The leaks, which were discharging as jet flow under pressure, varied in diameter from approximately 1/4 inch to 2 inches. The estimated total quantity, with lake level at the spillway crest, is 150 gallons/minute. At the time of the first inspection, November 15, 1979, the lake level was at the spillway crest but was approximately 2 feet below the spillway crest at the time of the second inspection, November 23, 1979. It is assumed that most of the water lost from the lake during the time between inspections discharged through the dam as leakage. At the time of the second inspection, when the lake level was approximately 2 feet below the spillway crest, the leakage was observed to be considerably less in quantity than the leakage observed when the lake level was at the spillway crest.

Orange deposits were noted among the rocks approximately 15 feet downstream from the dam. It was not determined whether these were due to leakage through the dam or seepage under the dam.

The stone masonry training walls at either end of the spillway appeared to be structurally stable and in generally satisfactory condition with patching and pointing of the stones noted.

c. Embankments

Both embankments are generally grass covered with a paved roadway located along the crest. Also, brush and tree growth was observed on both embankments.

The upstream face of the east embankment consists of a continuation of the east training wall of the spillway. The upstream face of the west embankment consists, in part, of a continuation of the west training wall.

Both embankments appeared to be outwardly structurally stable with no evidence of distress observed. Also, no significant erosion nor seepage was observed.

d. Bridge

The timber roadway, steel beams and chain link fence appeared to be in satisfactory condition. The stone masonry piers upon which the bridge rests appeared to be structurally sound with extensive patching and pointing noted.

e. Reservoir Area

Campbells Pond is bordered by woods along its east bank and by a paved road along its west bank. A brick pump house is located on the east bank of the lake approximately 300 feet from the dam.

f. Downstream Channel

The spillway discharges directly into the West Branch of the Rahway River which is a well defined stream with a bottom of cobbles and boulders. Approximately 1700 feet from the dam the stream widens into Diamond Mill Pond which has a surface area of approximately 3 acres and is impounded by a masonry and earth dam approximately 12 feet high.

A paved road (Brookside Drive) is located along the channel and varies in height above the stream bed from 4 feet to 8 feet. Approximately 2700 feet from the dam, the channel passes under Glen Avenue and into an urban area of Millburn. Buildings near the channel lie approximately 7 feet to 8 feet above the stream bed.

Extensive debris including large pieces of broken concrete was observed in the downstream channel in the immediate vicinity of the dam. Also, a few apparent well casings were observed in and adjacent to the channel immediately downstream from the dam. A small abandoned well pump house was noted adjacent to the channel in the vicinity of the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Campbells Pond is regulated naturally by discharge over the masonry spillway portion of the dam. In addition, the lake water level apparently drops during dry weather due to leakage in the dam. Reportedly, the lake becomes dry during the summer season almost every year.

4.2 Maintenance of the Dam

Reportedly, there is no program of regular maintenance of the dam and appurtenant structures. Maintenance is performed on an "as needed" basis by the City of Orange Water Department which also conducts an annual inspection of the bridge.

Recent maintenance reportedly includes a cleaning of the downstream area of the dam and a patching, by concrete, of the downstream face of the spillway about 3 years ago. In addition, the lake bed reportedly is dredged each summer that it becomes dry.

4.3 Maintenance of Operating Facilities

The recording lake level gage located in the abandoned pump house is maintained in operating condition on an "as needed" basis.

4.4 Description of Warning System

Reportedly, no formal warning system is in use at the present time. However, surveillance is maintained by the City of Orange Water Department on a daily basis.

4.5 Evaluation of Operational Adequacy

The apparent absence of a functioning outlet works contributes to a poor operational adequacy of the dam.

Maintenance documentation is poor and the maintenance program for the dam appears to be insufficient in the following areas:

1. Trees and brush on embankments.
2. Section of timber strip at crest of spillway broken away.
3. Extensive leaking of masonry portion of dam (spillway).
4. Extensive debris in immediate downstream area of dam.
5. Stones dislodged and displaced from downstream face of spillway.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The quantity of storm water runoff that the spillway should be able to pass without an overtopping of the dam is based on the size and hazard classification of the dam. This runoff, called the Spillway Design Flood (SDF), is described in terms of frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dam," published by the U.S. Army Corps of Engineers, the SDF for Campbells Pond Dam falls in a range of 100-year frequency to 1/2 PMF. In this case the high end of the range, 1/2 PMF, is chosen because of the hazard potential caused by the road downstream from the dam.

The SDF hydrograph for Campbells Pond was computed by use of the HEC-1-DB computer program using Clark's Method employing parameters supplied by the Corps of Engineers. Hydrologic computations and computer output are contained in Appendix 4. The calculated SDF peak inflow for Campbells Pond Dam is 4529 c.f.s.

Discharge capacity for the spillway was computed by considering free discharge over the masonry portion of the dam. Hydraulic computations are contained in Appendix 4.

The elevation of the crest of dam varies from 218.5 to 222.0 For purposes of computer input, the top of dam was taken as 222.0. However, for overtopping analysis, the top of dam was assumed to be 218.5.

A routing of the SDF through Campbells Pond resulted in an overtopping of the dam by a depth of 0.6 feet. The overtopping would occur at the west end of the dam which has the lowest elevation (218.5) of any point on the dam. Accordingly, the subject spillway is assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

Reportedly, the dam has not been overtopped due to high lake water level. However, the roadway downstream from the dam reportedly is occasionally inundated during periods of heavy precipitation.

c. Visual Observations

No evidence was found at the time of inspection that would indicate that the dam had been overtopped.

d. Overtopping Potential

As indicated in paragraph 5.1.a., a storm of magnitude equivalent to the SDF would cause overtopping of the dam by a height of 0.6 feet above the top of the dam. The spillway is capable of passing approximately 42% of the PMF or 84% of the SDF with lake level equal to the top of the dam (elev. 218.5).

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The embankments appeared, at the time of inspection to be outwardly stable. However, the masonry portion of the dam appeared marginally stable because of its numerous leaks and slight displacement at the toe and the presence of possible seepage containing orange deposits downstream from the toe.

An accurate determination of the severity of the observed indications of possible distress cannot be made without further investigation beyond the scope of a Phase I inspection.

b. Generalized Soils Description

The generalized soil description of the dam site consists of alluvial soil composed of stratified materials deposited by streams overlying glacial terminal moraine. The moraine consists of silt, sandy silt and silty sand with varying amounts of gravel and small amounts of clay deposited at the outer edge of the ice sheet during the Wisconsin stage of continental glaciation. The glacial terminal moraine overlies "Newark" basalt bedrock.

c. Design and Construction Data

Analysis of structural stability and construction data for the embankment and spillway structure are not available.

d. Operating Records

No operating records are available for the dam. Reports of inspections made by the State of New Jersey in 1928 and 1929 are contained in the files of the NJDEP. According to the reports, several leaks were present in the masonry portion of the dam. The leaks were assessed as being of a nature that did not threaten the structural integrity of the dam. Suggestions for remedial measures were withheld pending further investigations.

e. Post Construction Changes

No records of any post construction changes are available.

f. Seismic Stability

Campbells Pond Dam is located in Seismic Zone 1 as defined in "Recommended Guideline for Safety Inspection of Dams," which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if stable under static loading conditions. Campbells Pond Dam appeared at the time of inspection to be outwardly stable.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Campbells Pond Dam is assessed as being inadequate.

The masonry portion of the dam exhibits extensive leakage and other indications of possible distress. The condition of the dam indicates that it could become unstable if corrective measures are not implemented.

b. Adequacy of Information

Information sources for this study include: 1) field inspections, 2) USGS quadrangle, 3) aerial topography, 4) aerial photography 5) inspection reports in NJDEP file and 6) consultation with representatives of the City of Orange. The information outlined is sufficient to allow a Phase I assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some of the absent data are as follows:

1. Soils Report
2. Plans of the dam
3. Structural Design Report
4. Hydraulic Design Report

c. Necessity for Additional Data/Evaluation

Additional data and evaluation is considered necessary in order to assess the structural integrity of the dam.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a., the spillway is assessed as being inadequate. It is therefore recommended that a professional engineer experienced in the design and construction of dams be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of these analyses, the need for and type of mitigating measures should be determined and then implemented.

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future.

1) If it exists, the outlet works should be investigated and restored to a functional condition. If no outlet works exists, an adequate low level lake drain should be designed and installed.

2) The masonry portion of the dam should be thoroughly inspected by a professional engineer experienced in the design and construction of dams. The dam should be inspected with the lake drawn down and with the lake filled. Based on the inspections, together with any necessary subsoil, seepage and structural investigations, remedial measures to correct the leakage and other possible causes of distress should be determined and then implemented.

3) All adverse vegetation on the embankments should be removed.

4) Debris in the downstream channel should be removed.

b. Maintenance

In the near future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

PLATES

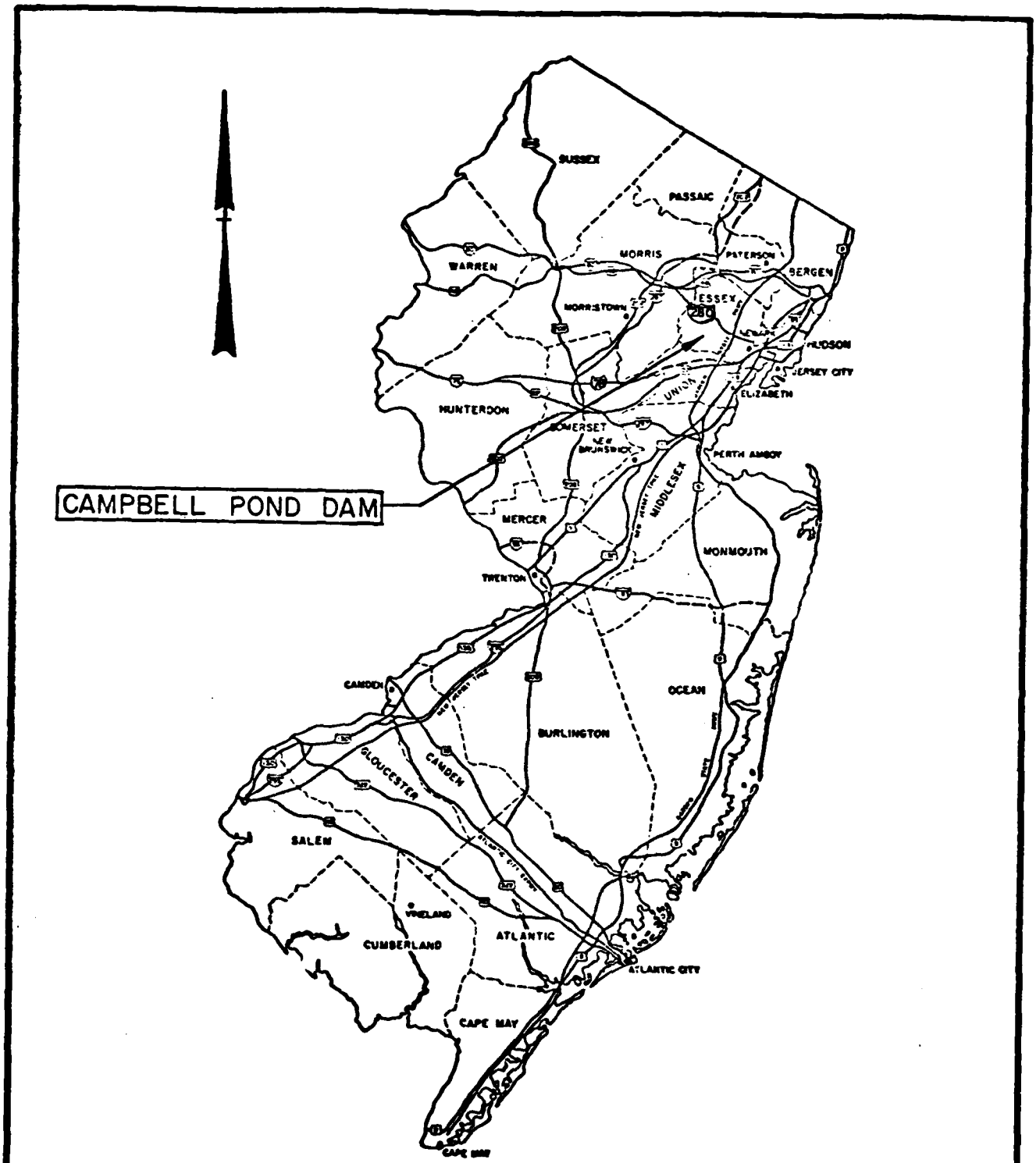


PLATE 1

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS KEY MAP CAMPBELL POND DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. N.J. 00517 / SCALE: NONE DATE: NOV., 1979

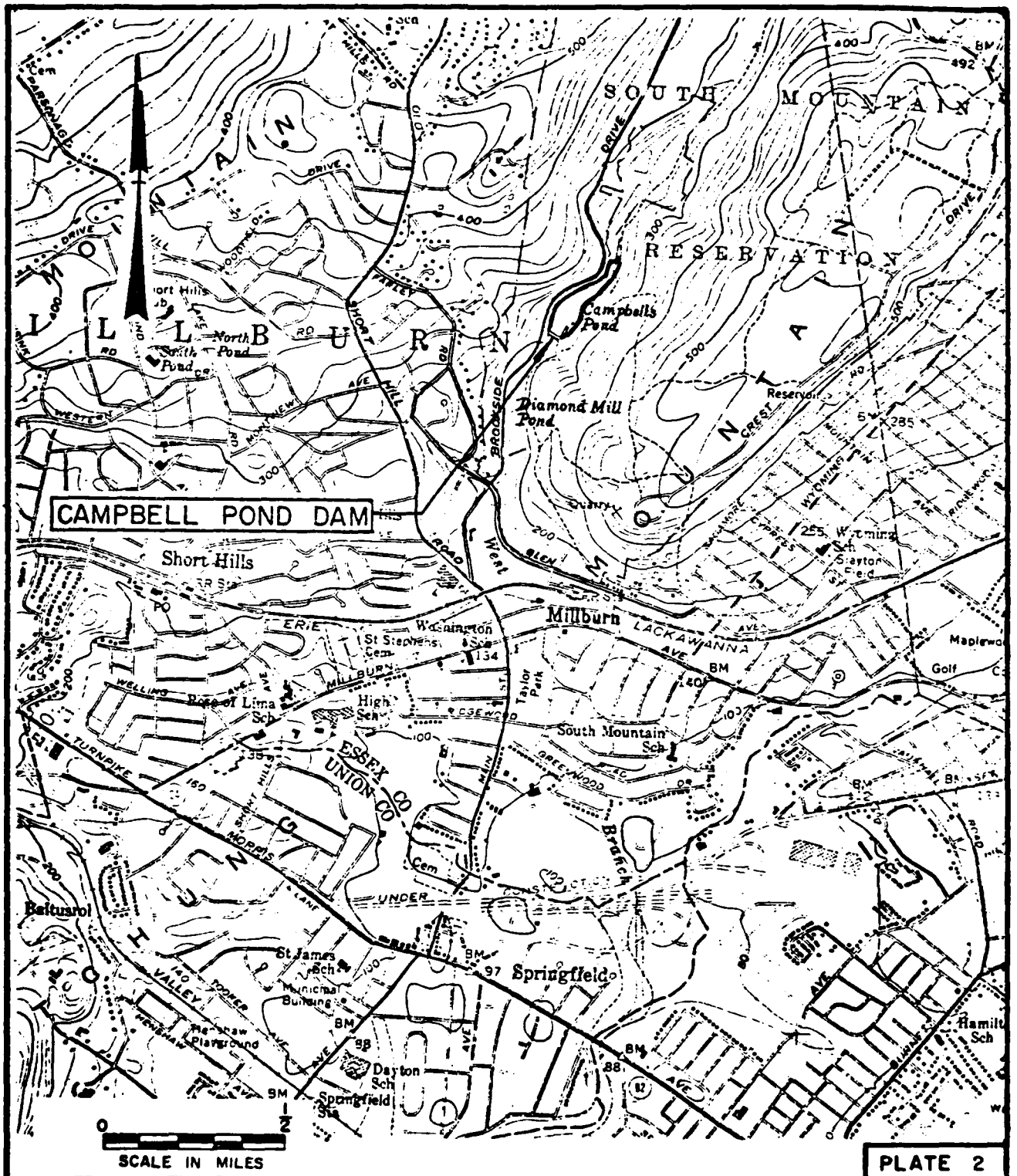
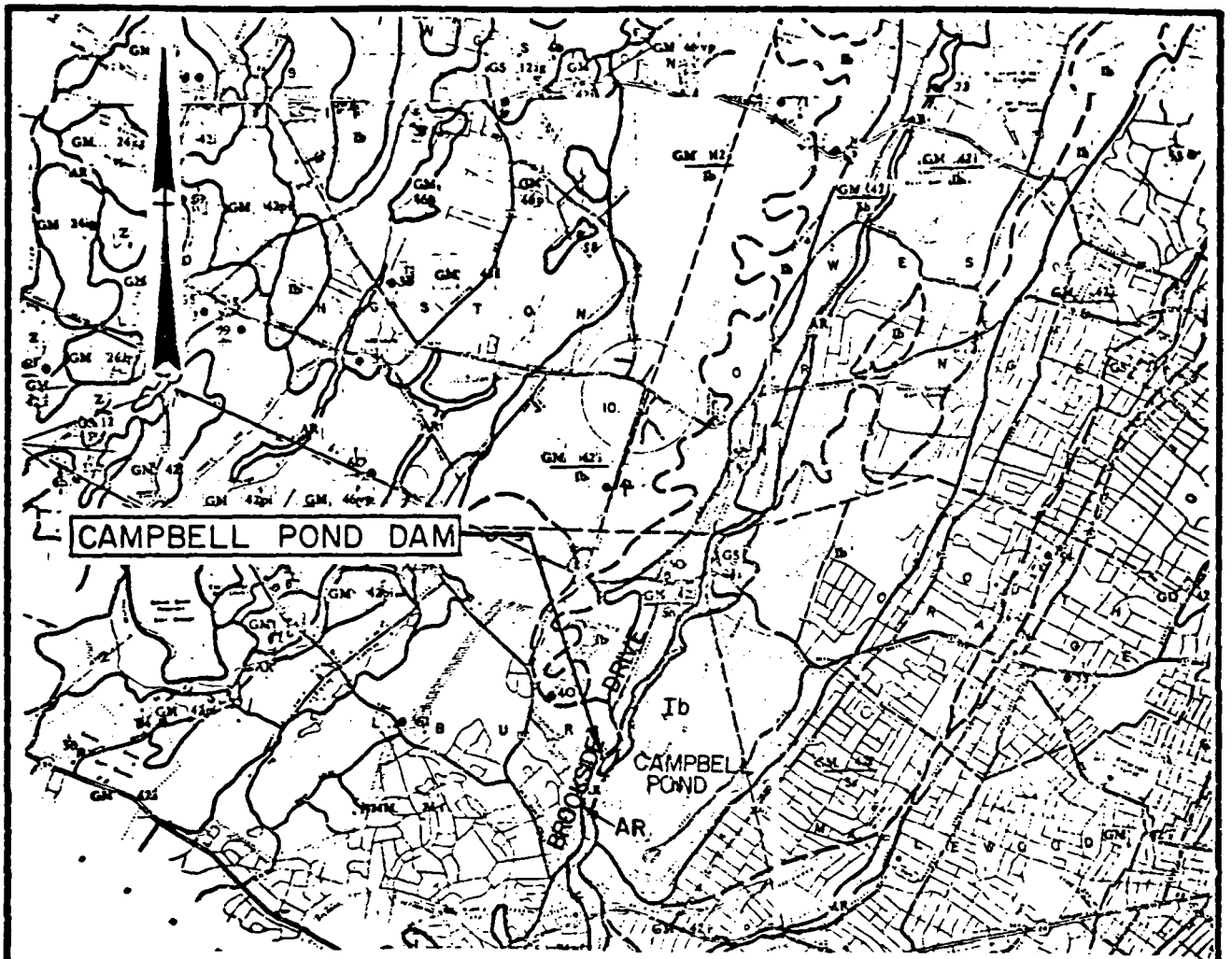


PLATE 2

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS VICINITY MAP CAMPBELL POND DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. N.J.00517 — SCALE: AS SHOWN DATE: NOV., 1979



Legend

AR	Recent alluvium composed of stratified materials deposited by streams.
GMM-24	Glacial Terminal moraine. Silt, sandy silt and silty sand with varying amounts of gravel and small amounts of clay deposited at the outer edge of the ice sheet during the Wisconsin stage of continental glaciation.
Ib	Triassic igneous rocks identified as "Newark" basalt and commonly called trap rock.

NOTE: Information taken from Rutgers University Soil Survey of New Jersey, Report No. 2, Essex County, and Geologic Map of New Jersey prepared by Lewis and Kummel.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

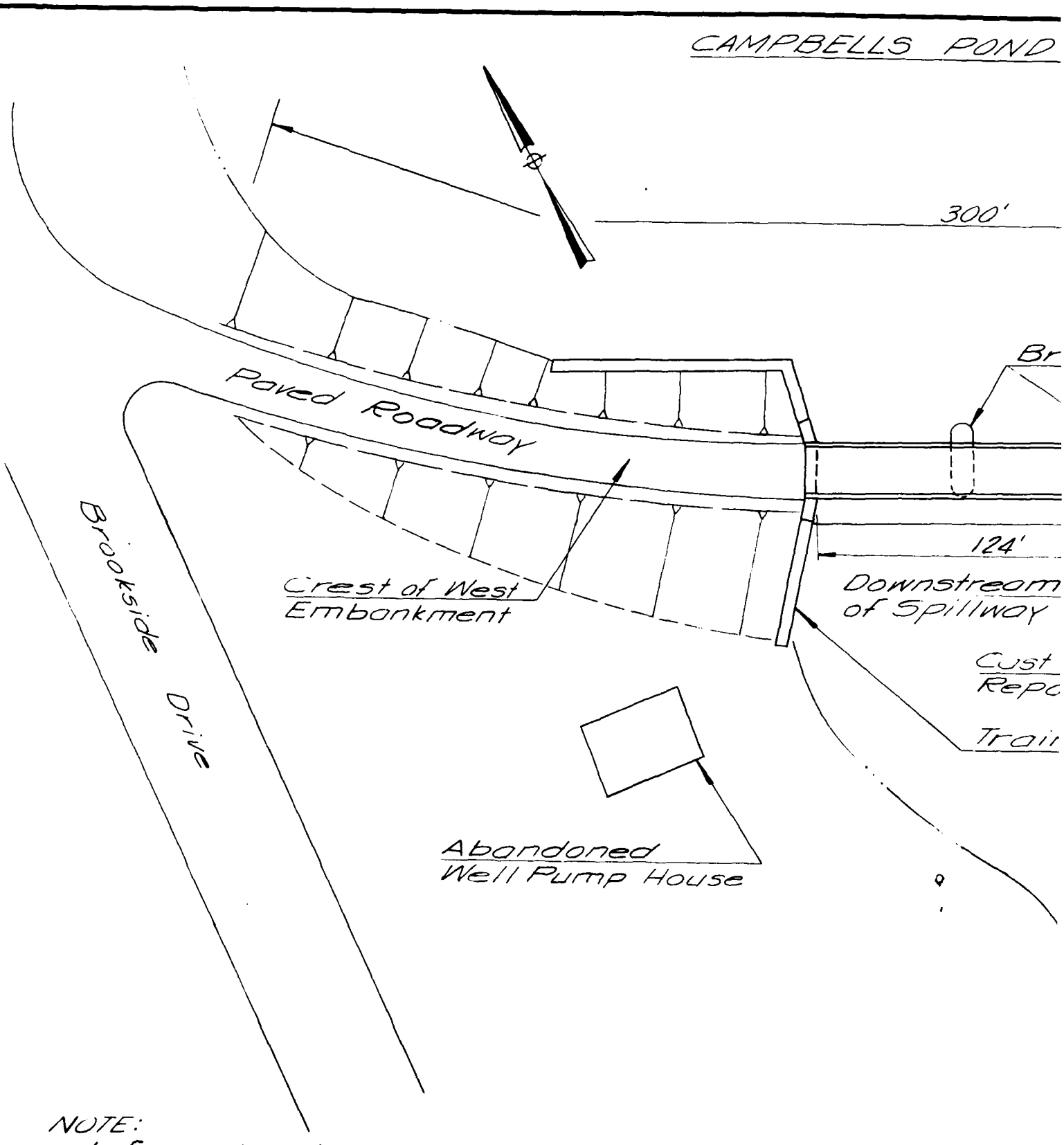
SOIL MAP

CAMPBELL POND DAM

I.D. NJ00517

SCALE: NONE

DATE: NOV., 1979



NOTE:
Information taken from field inspection November 15 & 23, 1979.

LS POND

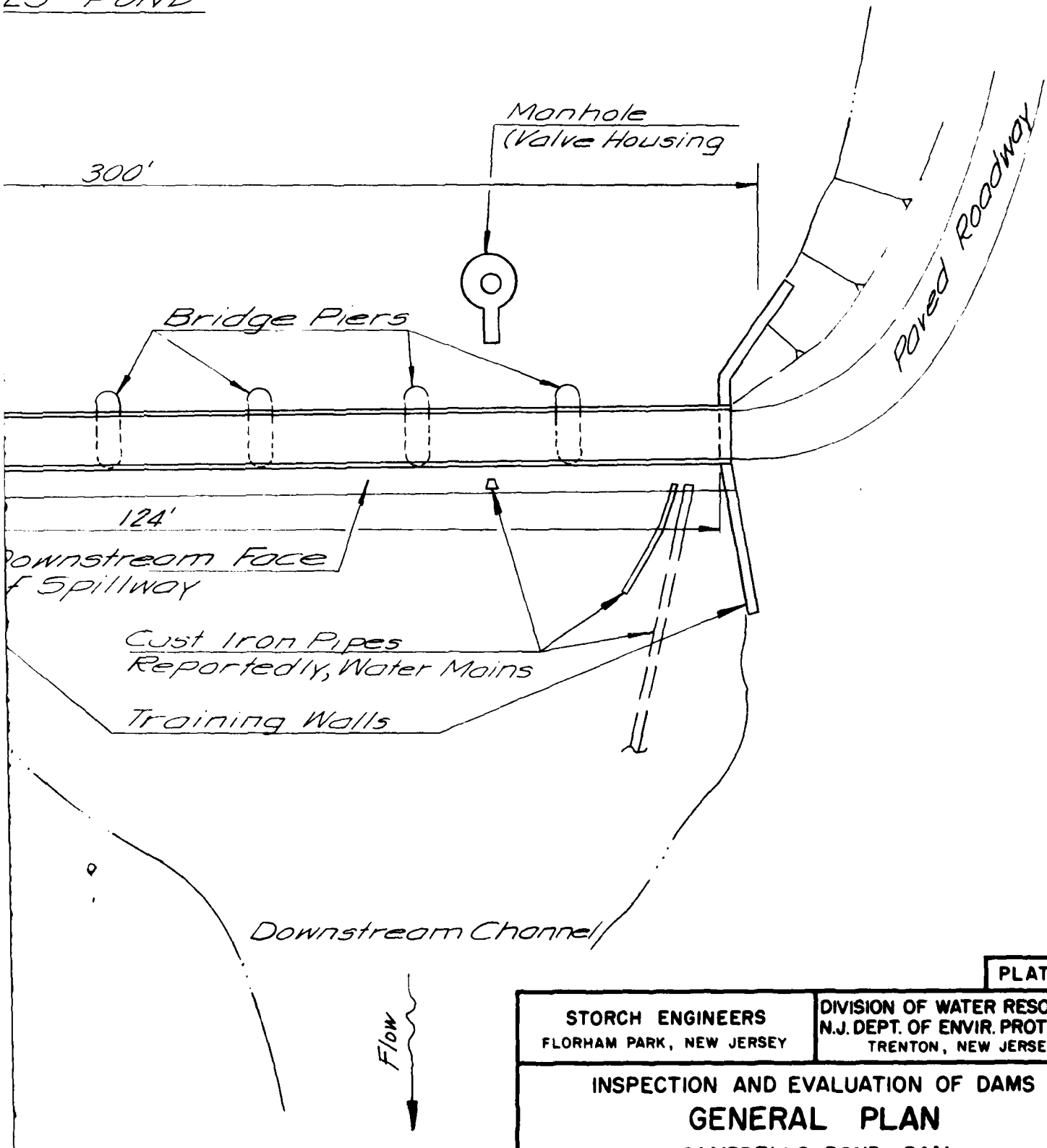


PLATE 4

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

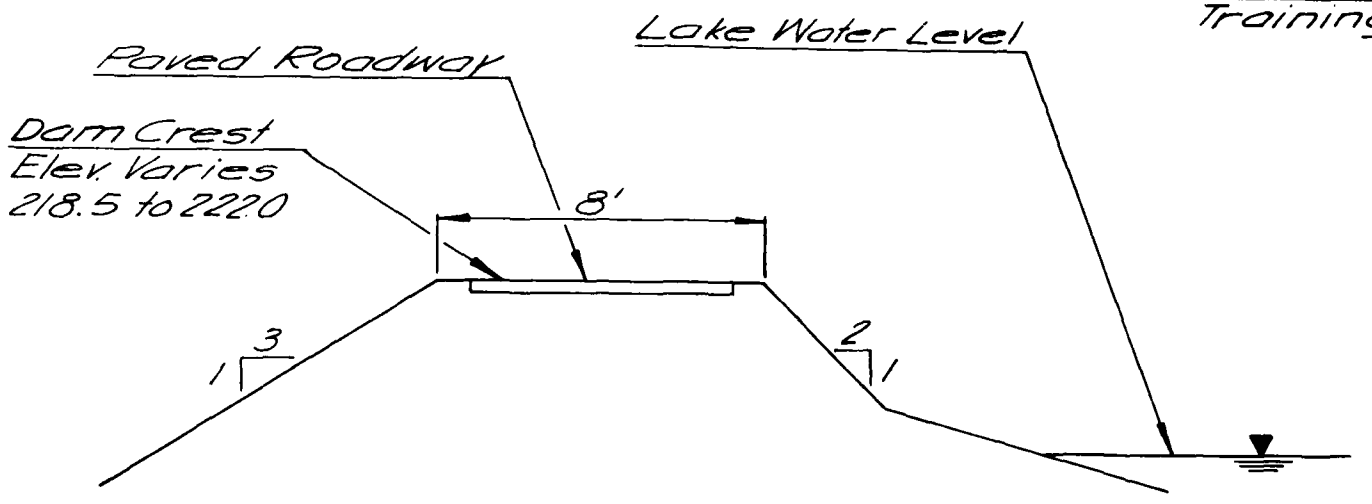
GENERAL PLAN

CAMPBELLS POND DAM

I.D. N.J. 00517	SCALE: NOT TO SCALE
	DATE: DEC., 1979

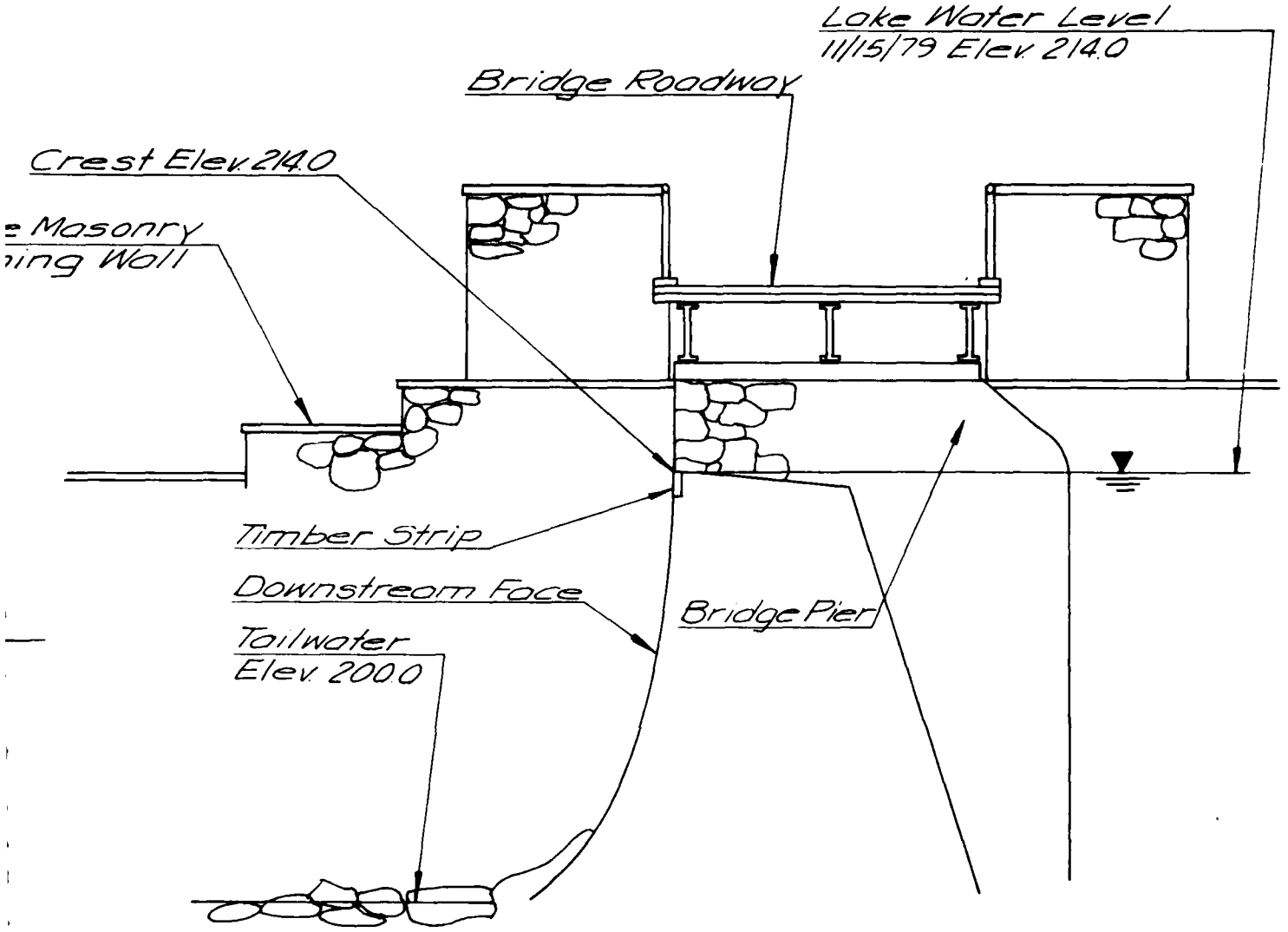
Crest El

Stone Masonry
Training Wall



DAM SECTION

NOTES:
1. Information taken from field inspections November 15 & 23 1979
2. Elevations based on N.G.V.D. estimated from U.S.G.S. quadrangle.



SPILLWAY SECTION

PLATE 5

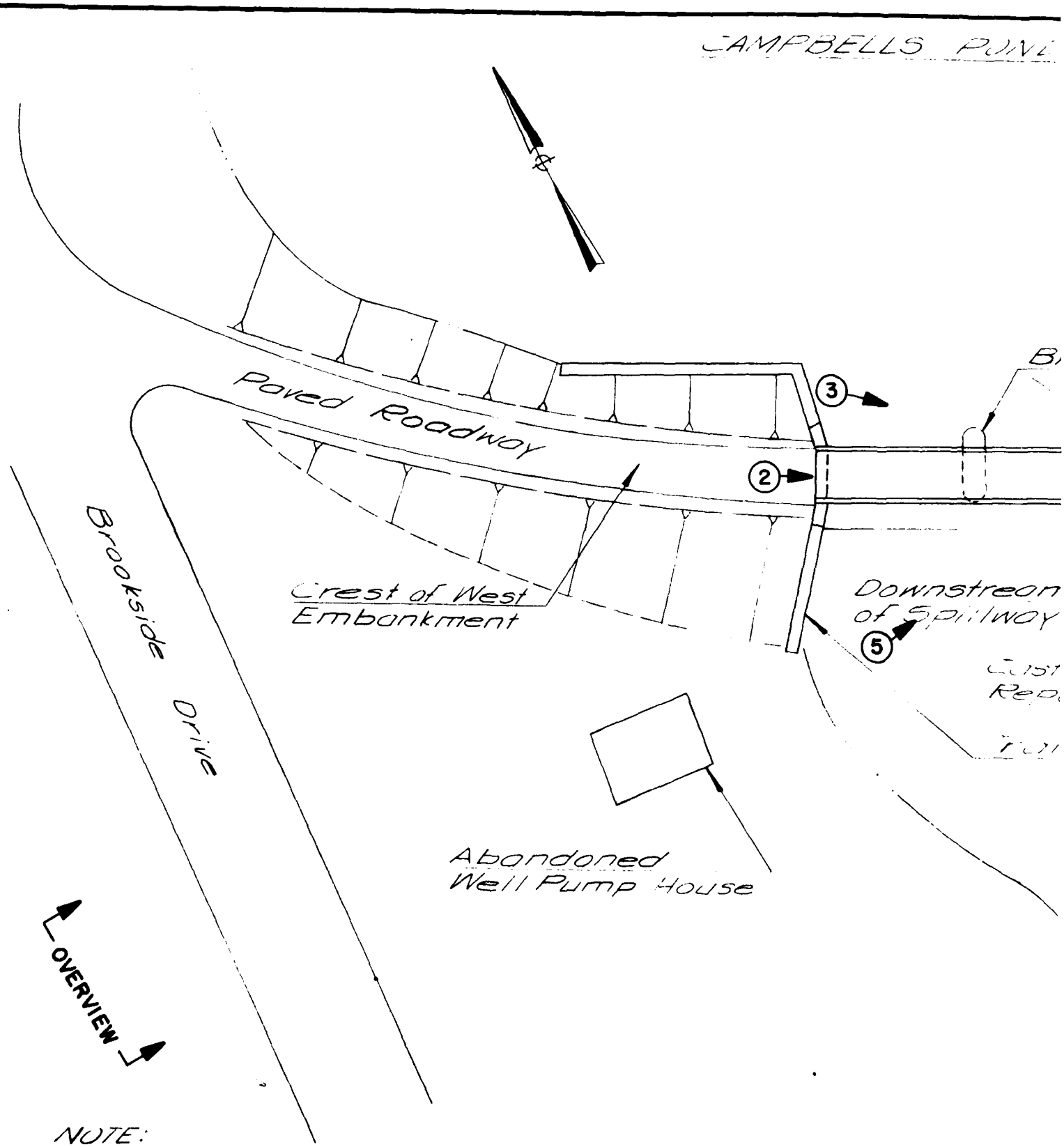
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SECTIONS

CAMPBELLS POND DAM

I.D. N.J.00517	SCALE: NOT TO SCALE
	DATE: DEC., 1979



NOTE:
Information taken from field inspection November 15 & 23, 1979.

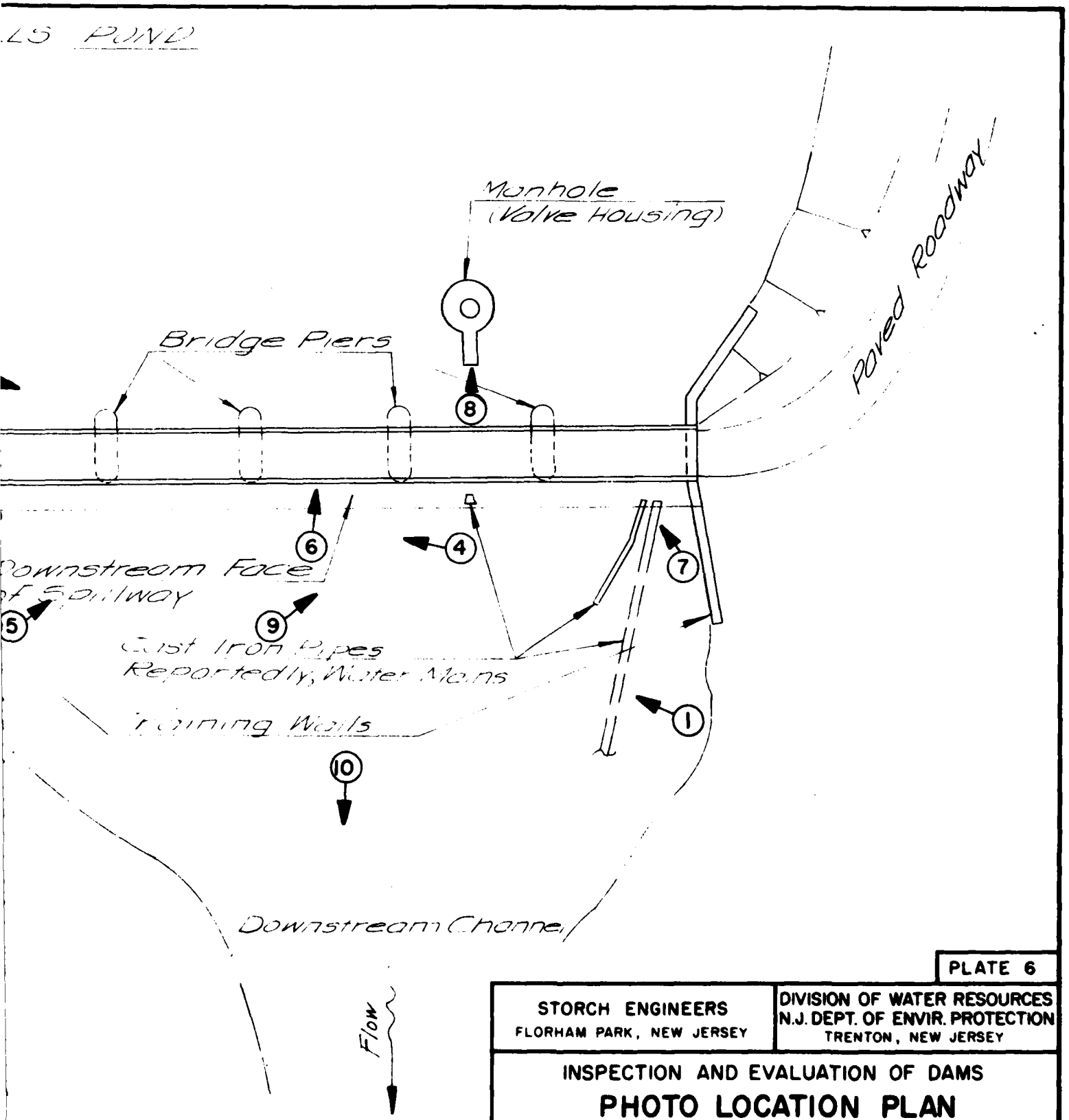


PLATE 6

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

CAMPBELLS POND DAM

I.D. N.J. 00517	SCALE: NOT TO SCALE
	DATE: DEC., 1979

APPENDIX 1

Check List - Visual Inspection
Check List - Engineering Data

Check List
Visual Inspection
Phase I

Name of Dam Campbell Pond Dam County Essex State New Jersey Coordinators NJDEP

Date(s) Inspection 11/15/79, 11/23/79 Weather Cloudy Temperature 50°F

Pool Elevation at Time of Inspection 214.0 M.S.L. (11/15/79), 212.0 (11/23/79) Tailwater at Time of Inspection 200.0 M.S.L.

Inspection Personnel:

John Gribbin
Alan Volle
Ronald Lai
Thomas Miller
Richard McDermott

J. Gribbin Recorder

Present: Paul Vertiramo, Reservoir Attendant (11/15/79)

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Masonry overflow appeared structurally stable. Some stones near the toe were dislodged. A portion of downstream face at toe near center was slightly displaced possibly due to freeze-thaw cycles.	Overflow portion of dam composed of grouted stones.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Junctions at both ends of masonry overflow section appeared stable.	
DRAINS	None	Three cast iron pipes penetrate the masonry portion of dam. They did not appear to be drains.
WATER PASSAGES	None	
APRON	Concrete and masonry apron along toe of masonry portion of dam was in generally poor condition. Pieces of concrete were broken away.	Recommend further inspection and corrective measures.
VERTICAL AND HORIZONTAL ALIGNMENT	Appeared to be straight. Small section of spillway crest broken away.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Evidence of extensive patching and pointing observed on downstream face.	
STRUCTURAL CRACKING	Cracks observed in downstream face and training walls appeared to be surface cracks.	
CONSTRUCTION JOINTS	No distress observed.	
MONOLITH JOINTS	N.A.	
LEAKAGE	Numerous leaks observed on downstream face of masonry portion of dam. Total leakage approx. 150 gal./min. when lake level at top of spillway.	Recommend further inspection and corrective measures.
SEEPAGE	Flow of water containing orange deposits was emerging approx. 15 feet downstream from toe. Flow could be seepage under dam or accumulation of leakage through dam.	Further investigations are recommended.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Paved roadway on crest appeared to be in satisfactory condition. Numerous trees and brush growth.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appeared stable.	Spillway training walls extend along portion of upstream faces of embankments.
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None	
DRAINS	None observed.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some erosion at training walls.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical: west embankment crest pitches down from spillway to west end of dam. Horizontal: curved	
RIPRAP FAILURES	None observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	Reportedly, the dam has no outlet works.
INTAKE STRUCTURE	N.A.	
OUTLET STRUCTURE	N.A.	
OUTLET CHANNEL	N.A.	
GATE AND GATE HOUSING	N.A.	

SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Conc. weir fitted with timber strip at crest. Timber strip in generally good condition - one small portion broken away.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	Spillway discharges directly into downstream channel.	
BRIDGE AND PIERS	Bridge in generally satisfactory condition. Masonry piers appeared to be in satisfactory condition. Evidence of extensive pointing was observed.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Recording lake level gage located in original pump house on east bank of lake.	Lake level monitored by maintenance personnel

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Shore slopes have average pitch of approx. 20%. Entire shore of lake is wooded.	
SEDIMENTATION	Soundings in vicinity of spillway indicate silt deposits approx. 6 feet thick.	
STRUCTURES ALONG BANKS	Original brick pump house (no longer functioning) located on east bank. Paved road located along west bank.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Considerable debris was present immediately downstream from the dam. Further downstream, the channel is well defined, rock lined and free of significant obstructions.	Recommend removal of debris.
SLOPES	The banks have slopes of approximately 4:1 and are wooded.	
STRUCTURES ALONG BANKS	No buildings are located along the channel for approx. 2700 feet downstream. A small lake and masonry dam is located approx. 1700 feet downstream from the dam. A paved road (Brookside Drive) is located along the channel bank for approx. 2500 feet. A road bridge is located 2700 feet from dam.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
DAM - PLAN	Not Available
SECTIONS	
SPILLWAY - PLAN	Not Available
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Not Available
OUTLETS - PLAN	Reportedly, no outlet
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	
HYDRAULIC/HYDROLOGIC DATA	Not Available
RAINFALL/RESERVOIR RECORDS	Lake level gaging records available - City of Orange, Engineer's Office
CONSTRUCTION HISTORY	Not Available
LOCATION MAP	Available - City of Orange, Engineers Office

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	Lake level gaging records on file at Orange City Engineers Office.
MODIFICATIONS	Not Available
HIGH POOL RECORDS	Lake level gaging records available. - City of Orange, Engineer's Office
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Inspection reports available in NJDEP file.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None

APPENDIX 2

Photographs

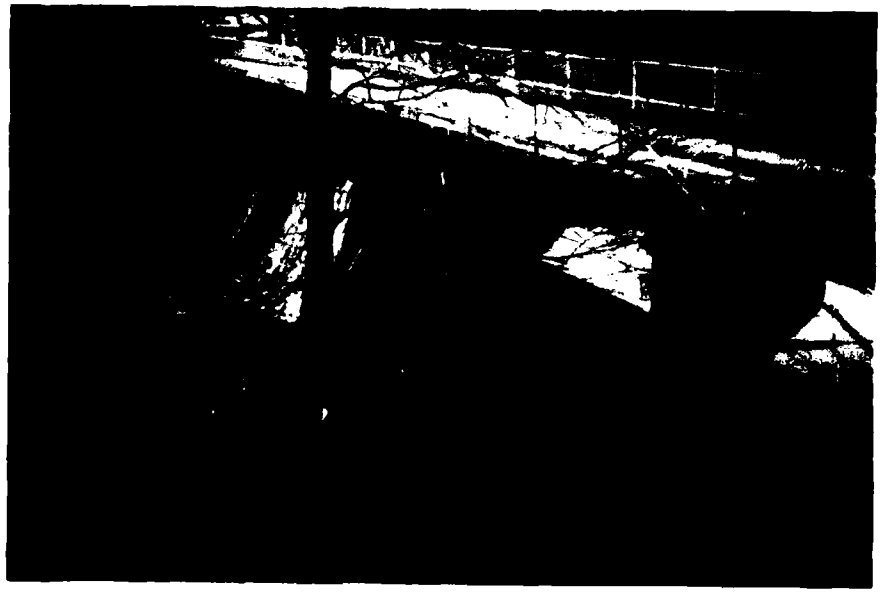


PHOTO 1

MASONRY SPILLWAY AND BRIDGE

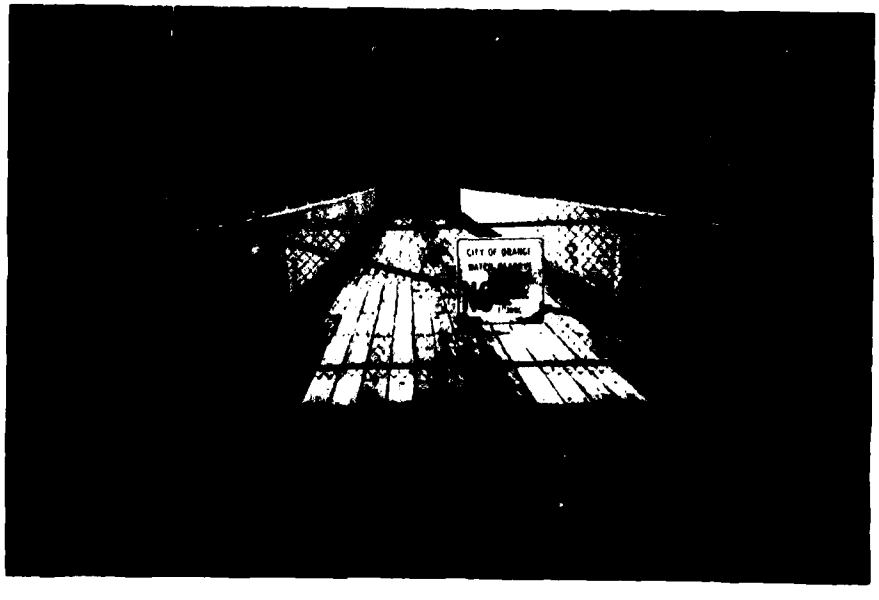


PHOTO 2

TOP OF DAM - BRIDGE OVER SPILLWAY

CAMPBELLS POND DAM

15 NOVEMBER 1979

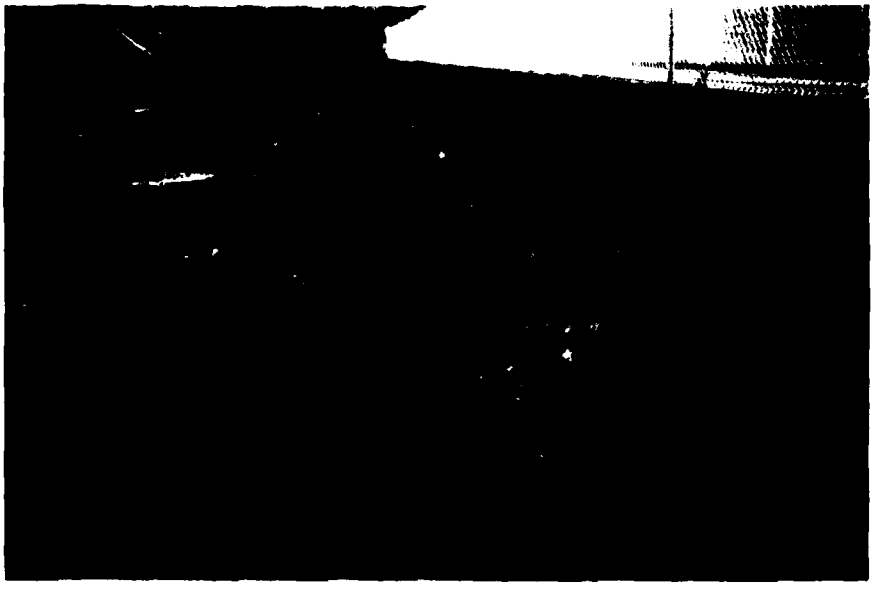


PHOTO 3
UPSTREAM FACE OF SPILLWAY

PHOTO 4
DOWNSTREAM FACE OF SPILLWAY

CAMPBELLS POND DAM
23 NOVEMBER 1979

PHOTO 5 — 15 NOVEMBER 1979

LEAKS IN DOWNSTREAM FACE OF SPILLWAY

PHOTO 6 — 23 NOVEMBER 1979

DETERIORATION AT TOE OF DAM - STONES DISLODGED

PHOTO 7 15 NOVEMBER 1979

WATER TRANSMISSION PIPES PENETRATING TOE OF DAM

PHOTO 8 23 NOVEMBER 1979

MANHOLE UPSTREAM FROM DAM REPORTEDLY HOUSING WATER MAIN VALVE

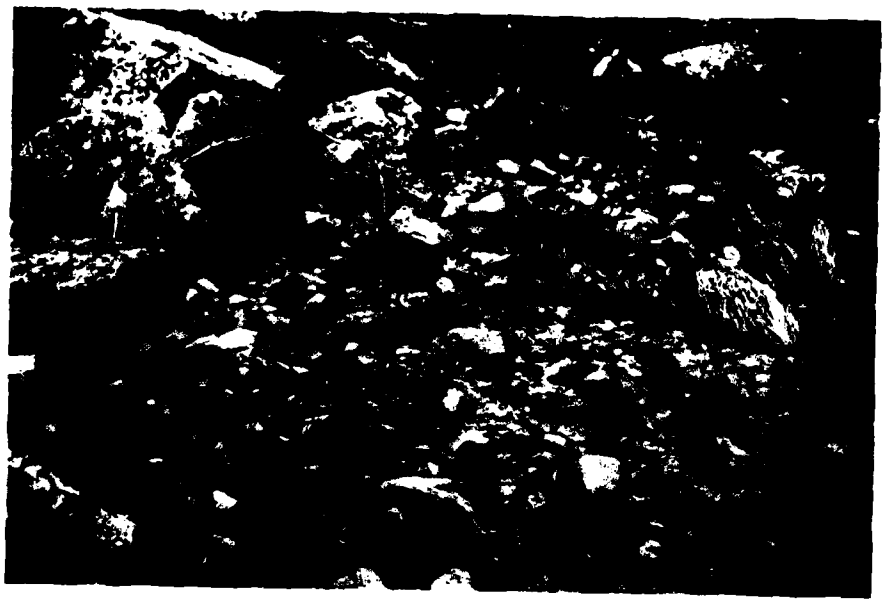


PHOTO 9 23 NOVEMBER 1979

ORANGE DEPOSITS IN SUSPECTED SEEPAGE

PHOTO 10 15 NOVEMBER 1979

DOWNSTREAM CHANNEL

CAMPBELLS POND DAM

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Urban and Wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 214.0 (21 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 219.1

ELEVATION TOP DAM: Varies: 218.5 to 222.0

SPILLWAY CREST: Straight Masonry Weir with Piers

a. Elevation 214.0
b. Type Irregular Section
c. Width 4 feet
d. Length 124 feet
e. Location Spillover Center of dam
f. Number and Type of Gates None

OUTLET WORKS: None

a. Type N.A.
b. Location N.A.
c. Entrance inverts N.A.
d. Exit inverts N.A.
e. Emergency draindown facilities: N.A.

HYDROMETEOROLOGICAL GAGES: Lake Water Level Gage

a. Type Recording
b. Location Abandoned Pump House
c. Records Orange City Engineer's File

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake stage equal to top of dam) 3748 c.f.s.
(Elev. 218.5)

APPENDIX 4

Hydraulic/Hydrologic Computations

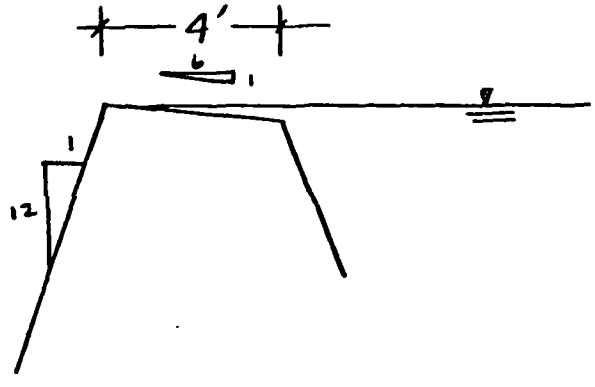
STORCH ENGINEERS

Sheet 1 of 8

Project Campbell Pond Dam Made By RL Date 11-21-79

Chkd By JG Date 12/14/79

Stage Discharge Calculation



Spillway Section

Discharge over weir will be calculated by

The formula : $Q = C L h^{3/2}$

Total length of spillway 124 feet

Effective length of spillway 119 feet

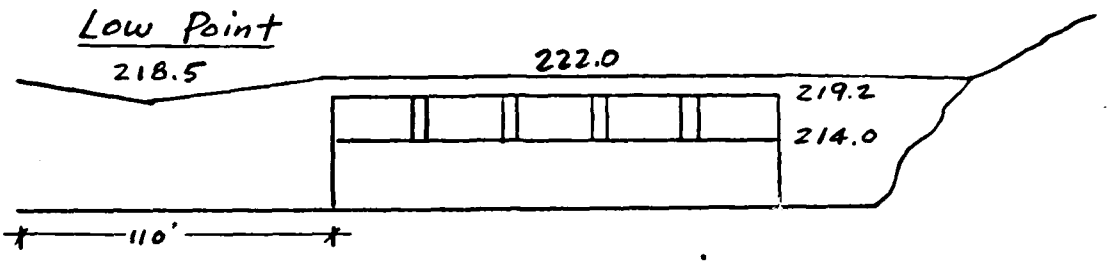
Correction for piers 5 feet

C use 3.3 Ref. "Handbook of Hydraulics" by Brater and King 5-44

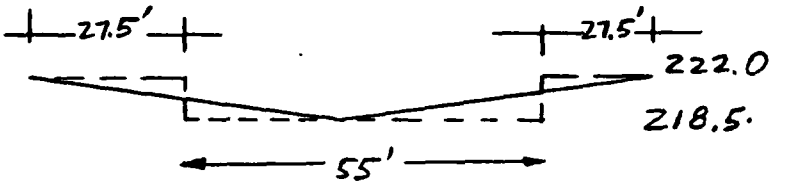
As water level rise above the bridge, discharge will be calculated as an orifice :

$$Q = 0.576 A \sqrt{2gh}$$

$A = 119 \times 5.2 = 618.8$ sq. ft.



Top Of Dam Profile



Low Point

Flow over low point will be calculated by broad crested weir formula :

$$Q = cLh^{3/2}$$

where $c = 2.63$
$L = 55$ feet

Flow over full length of dam crest will be calculated by HEC-1-DB program

Stage Discharge Tabulation

Water level (ft)	Q (cfs) Spillway	Q (cfs) Low Point	Q (cfs) Total
214	0	0	0
215	393	0	393
216	1111	0	1111
217	2041	0	2041
218	3142	0	3142
218.5	3748	0	3748
219	4391	45	4436
220	5725	255	5980
221	6513	558	7071
222	7215	921	8146

Top of dam elevation varies from 218.5 to 222.0

STORCH ENGINEERS

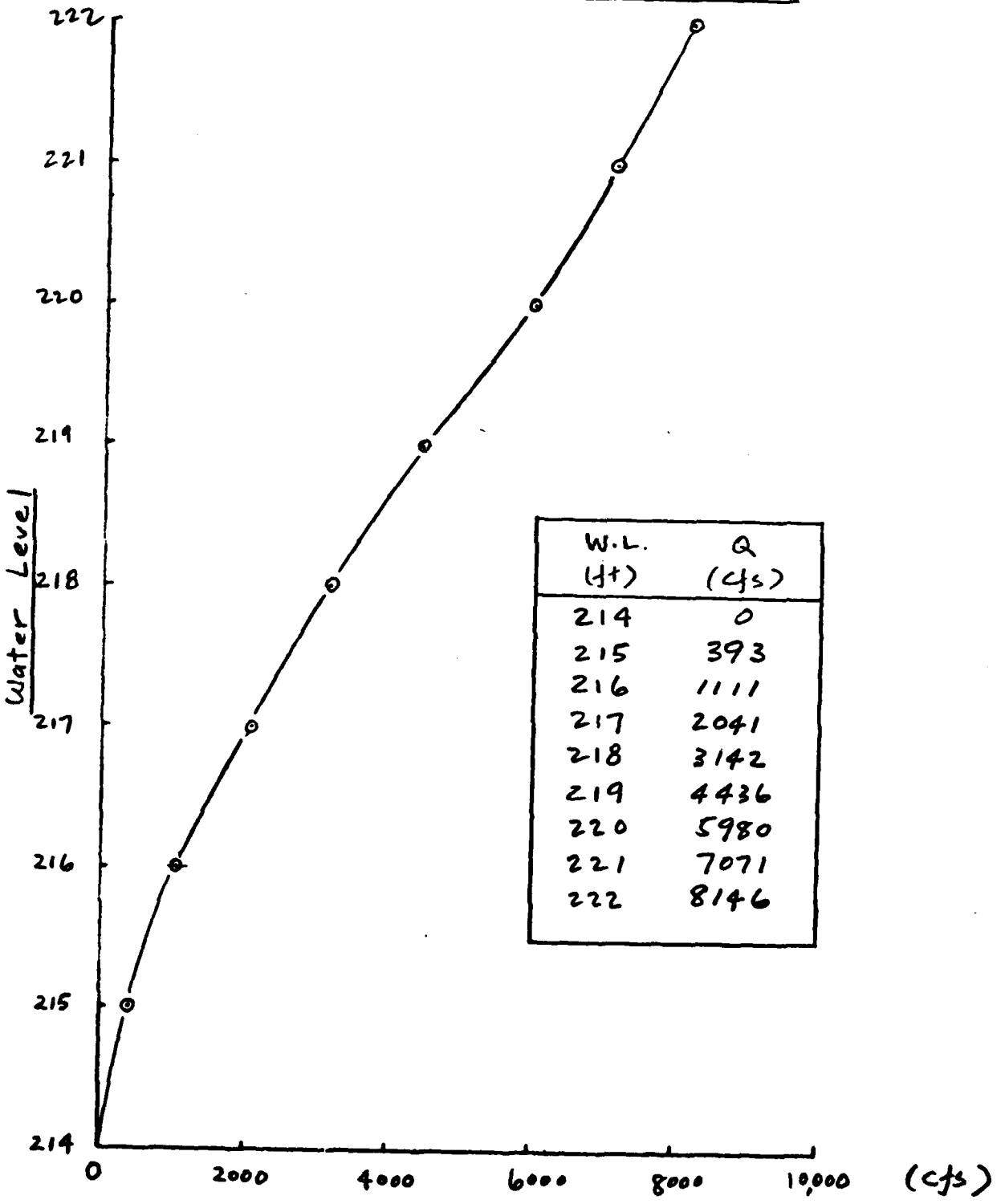
Project Campbell Pond Dam

Sheet 4 of 8

Made By RL Date 11-29-79

Chkd By JG Date 12/14/79

Stage Discharge Curve



W.L. (ft)	Q (cfs)
214	0
215	393
216	1111
217	2041
218	3142
219	4436
220	5980
221	7071
222	8146

STORCH ENGINEERS

Sheet 5 of 8

Project CAMPBELLS POND DAM Made By STO Date 12/10/79

Chkd By JG Date 12/14/79

HYDROLOGY

PRECIPITATION (Re. "DESIGN OF SMALL DAMS", USDI, 1977)

FROM FIGURE 15, ZONE 6

PROBABLE MAXIMUM PRECIPITATION = 25.7 INCHES
FOR 6 HOUR DURATION & 10 SQ. MILE AREA

DURATION (HOURS)	% PMP
6	100
12	109
24	117

INFILTRATION DATA

INITIAL INFILTRATION = 1.0 INCHES

CONSTANT INFILTRATION = 0.10 INCHES/HOUR

DRAINAGE AREA, D.A.

FROM USGS QUADRANGLES, ROSELLE, ORANGE, CALDWELL

DRAINAGE AREA = 6.4 SQUARE MILES

MAIN CHANNEL SLOPE, S FROM USGS QUADRANGLE

TOTAL CHANNEL LENGTH = 6.1 MILES

10% LENGTH = .61 MILES ; ELEVATION = 270

85% LENGTH = 5.2 MILES ; ELEVATION = 380

$S = \frac{380-270}{5.2-.61}$ S = 24 FEET/MILE

IMPERVIOUS COVER INDEX, I

(POPULATION TAKEN FROM CITY OF WEST ORANGE AND USGS QUADRANGLE)

POPULATION = 16,050

POPULATION DENSITY (D) = $\frac{16050}{64} \times 2500 \frac{\text{PERSONS}}{\text{SQ. MILE}}$

$I = 0.117\ D^{(0.792 - 0.039 \log D)}$ (FROM SPECIAL REPORT 38)

I = 20.37 %

TIME OF CONCENTRATION, T_C

USING CLARKS PARAMETERS SUPPLIED BY THE CORPS OF ENGINEERS

$T_C = 8.29\ (1.0 + 0.03\ I)^{-1.28}\ (DA/S)^{0.28}$

$\frac{R}{T_C + R} = 0.65$

I = 20.37%
DA = 6.4 SM
S = 24 FT/MILE

$T_C = 8.29\ [1.0 + 0.03\ (20.37)]^{-1.28}\ (64/24)^{0.28}$

T_C = 3.11 HOURS

$\frac{R}{3.11 + R} = 0.65$ R = 5.78 HOURS

STORCH ENGINEERS

Sheet 7 of 8

Project CAMPBELL POND DAM

Made By STO Date 12/12/79

Chkd By JG Date 12/14/79

LAKE STORAGE VOLUME (FROM USGS QUADRANGLE)

STAGE (FT)	SURFACE AREA (AC.)
200	0
214	4.59
220	18.36
240	35.81
260	62.44

HEC-1-DB PROGRAM WILL DEVELOP STORAGE CAPACITY FROM SURFACE AREA & ELEVATION.

STORCH ENGINEERS

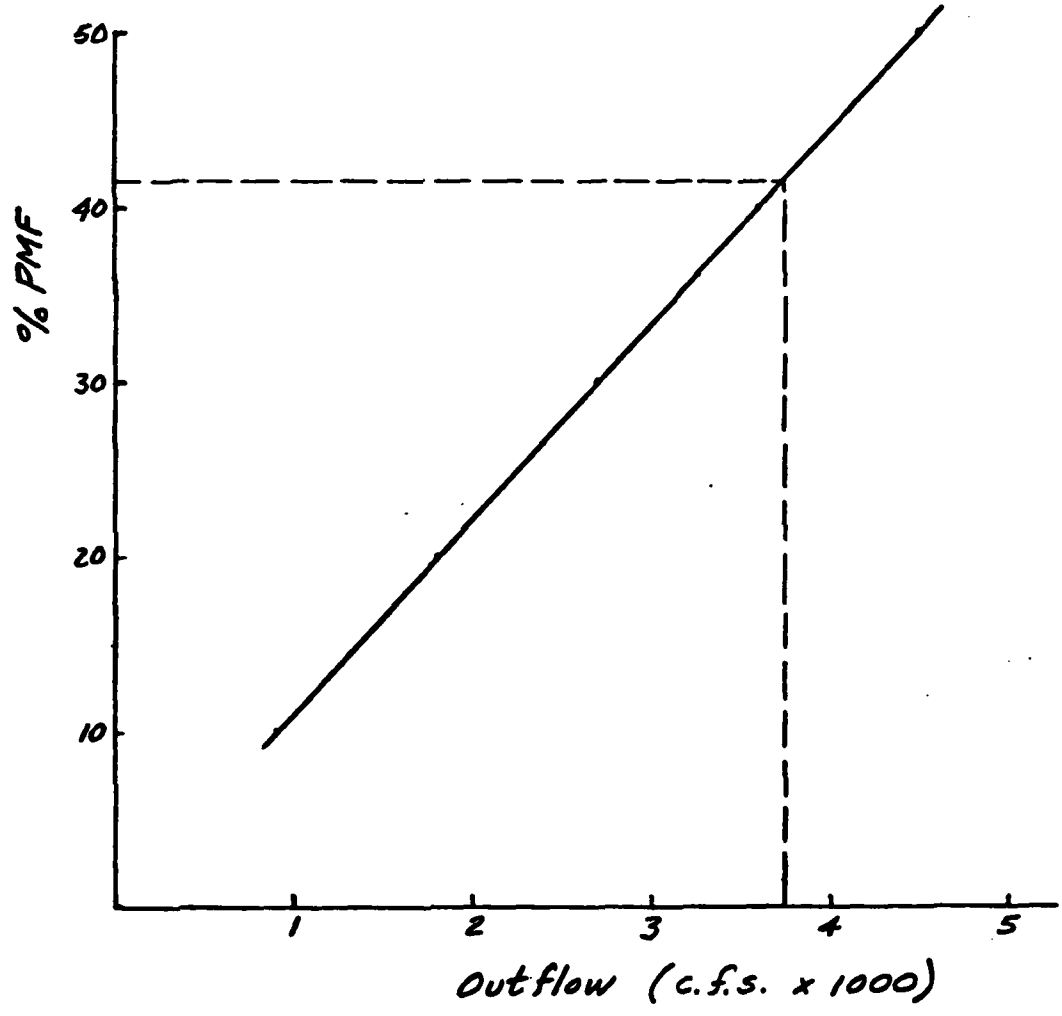
Sheet 8 of 8

Project Campbells Pond Dam

Made By JG Date 12/17/79

Chkd By _____ Date _____

Overtopping Potential



Overtopping occurs at elev. 218.5
with Q = 3748 c.f.s.

∴ Dam can pass approx 42% PMF

HEC-1-DB COMPUTATIONS

```
A1                NATIONAL DAM SAFETY PROGRAM
A2          CAMPBELL POND DAM, MILLBURN, NEW JERSEY
A3          PMF MULTI RATIO ROUTING
B     300          0          10                                          0          0          3
B1      5
J       1          5           1
J1    0.5        0.4         0.3        0.2        0.1
K       0       LAKE                                 0          0          1
K1                 INFLOW HYDROGRAPH TO CAMPBELL DAM
M       1          0         6.4                   6.4          0                                1
P       0       25.7         100        109        117
T                                                                1.0        0.1
V    3.11       5.78           0
X   -1.0       -0.35         2.0
K       1         DAM                                0          0          1
K1             ROUTED DISCHARGE THROUGH CAMPBELL DAM
Y                                      1          1
Y1      1                                                      -214         -1
Y4    214        215         216        217        218        219        220        221        222
Y5      0      392.7      1110.7     2040.5     3141.6     4435.6     5980.0     7070.6     8145.7
$A      0       4.59       18.36      35.81      62.44
$E    200        214         220        240        260
$$    214
$D    222       2.63          1.5        245
K      99
A
A
A
A
A
```

```
**********
*FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/12/13.
     TIME= 08.37.57.
```

NATIONAL DAM SAFETY PROGRAM
CAMBELL POND DAM, MILLBURN, NEW JERSEY
PMF MULTI RATIO ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	5	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .50 .40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO CAMPBELL DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	6.40	0.00	6.40	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	25.70	100.00	109.00	117.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 3.11 R= 5.78 NTA= 0

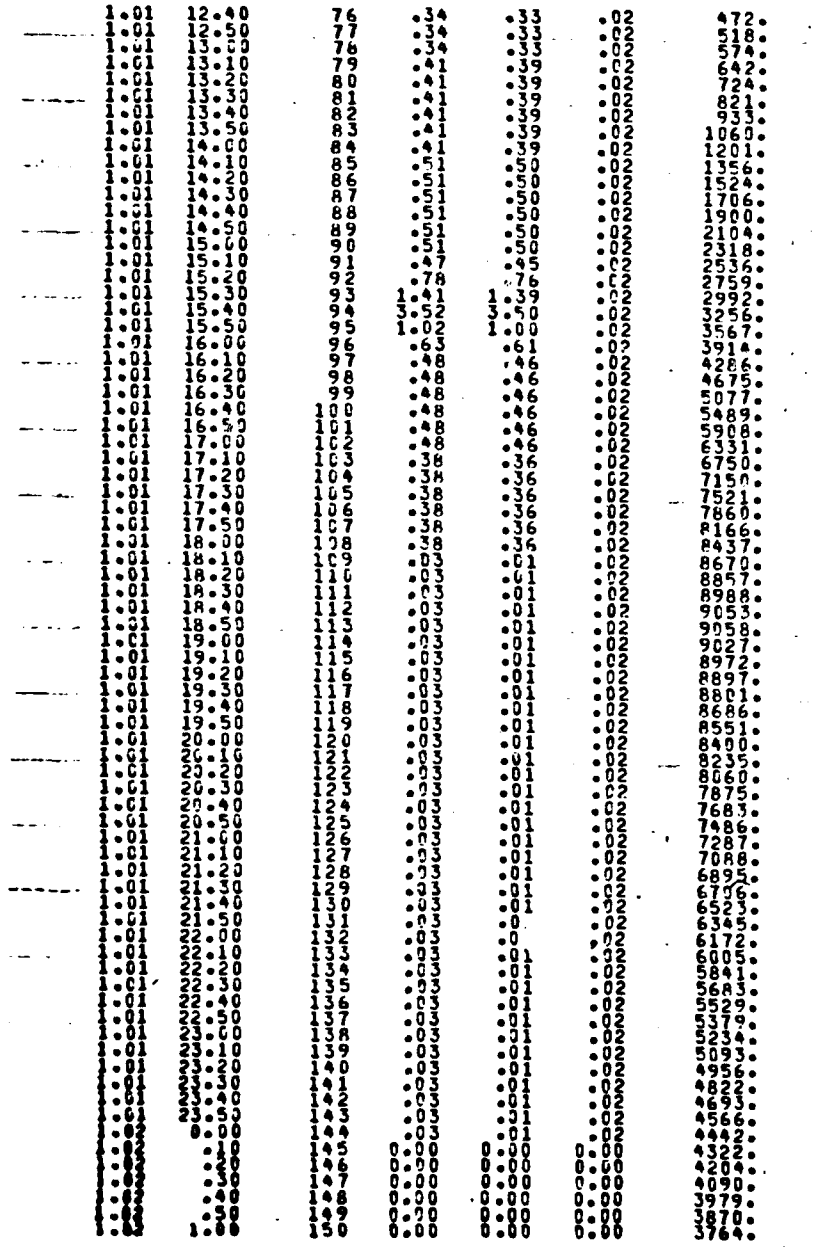
RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 3.07 HOURS, CP= .40 VOL= .93

6.	23.	49.	79.	114.	152.	193.	237.	282.	329.
374.	415.	451.	482.	508.	529.	544.	552.	550.	537.
522.	507.	493.	479.	465.	452.	439.	427.	414.	403.
391.	380.	369.	359.	349.	339.	329.	320.	311.	302.
293.	285.	277.	269.	261.	254.	247.	240.	233.	226.
220.	213.	207.	202.	196.	190.	185.	180.	174.	170.
165.	160.	155.	151.	147.	143.	139.	135.	131.	127.
123.	120.	117.	113.	110.	107.	104.	101.	98.	95.
93.	90.	87.	85.	82.	80.	78.	76.	73.	71.
69.	67.	65.	64.	62.	60.	58.	57.	55.	53.

PMF HYDROGRAPH

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.02	0.00	.02	6.
1.01	.20	2	.02	0.00	.02	6.
1.01	.30	3	.02	0.00	.02	5.
1.01	.40	4	.02	0.00	.02	5.
1.01	.50	5	.02	0.00	.02	5.
1.01	1.00	6	.02	0.00	.02	4.
1.01	1.10	7	.02	0.00	.02	4.
1.01	1.20	8	.02	0.00	.02	4.
1.01	1.30	9	.02	0.00	.02	3.
1.01	1.40	10	.02	0.00	.02	3.
1.01	1.50	11	.02	0.00	.02	3.
1.01	2.00	12	.02	0.00	.02	3.
1.01	2.10	13	.02	0.00	.02	3.
1.01	2.20	14	.02	0.00	.02	2.
1.01	2.30	15	.02	0.00	.02	2.
1.01	2.40	16	.02	0.00	.02	2.
1.01	2.50	17	.02	0.00	.02	2.
1.01	3.00	18	.02	0.00	.02	2.
1.01	3.10	19	.02	0.00	.02	2.
1.01	3.20	20	.02	0.00	.02	2.
1.01	3.30	21	.02	0.00	.02	1.
1.01	3.40	22	.02	0.00	.02	1.
1.01	3.50	23	.02	0.00	.02	1.
1.01	4.00	24	.02	0.00	.02	1.
1.01	4.10	25	.02	0.00	.02	1.
1.01	4.20	26	.02	0.00	.02	1.
1.01	4.30	27	.02	0.00	.02	1.
1.01	4.40	28	.02	0.00	.02	1.
1.01	4.50	29	.02	0.00	.02	1.
1.01	5.00	30	.02	0.00	.02	1.
1.01	5.10	31	.02	0.00	.02	1.
1.01	5.20	32	.02	0.00	.02	1.
1.01	5.30	33	.02	0.00	.02	1.
1.01	5.40	34	.02	0.00	.02	1.
1.01	5.50	35	.02	0.00	.02	1.
1.01	6.00	36	.02	0.00	.02	1.
1.01	6.10	37	.05	0.00	.05	0.
1.01	6.20	38	.05	0.00	.05	0.
1.01	6.30	39	.05	0.00	.05	0.
1.01	6.40	40	.05	0.00	.05	0.
1.01	6.50	41	.05	0.00	.05	0.
1.01	7.00	42	.05	0.00	.05	0.
1.01	7.10	43	.05	.01	.04	0.
1.01	7.20	44	.05	.03	.02	1.
1.01	7.30	45	.05	.03	.02	2.
1.01	7.40	46	.05	.03	.02	4.
1.01	7.50	47	.05	.03	.02	7.
1.01	8.00	48	.05	.03	.02	11.
1.01	8.10	49	.05	.03	.02	17.
1.01	8.20	50	.05	.03	.02	24.
1.01	8.30	51	.05	.03	.02	33.
1.01	8.40	52	.05	.03	.02	44.
1.01	8.50	53	.05	.03	.02	56.
1.01	9.00	54	.05	.03	.02	69.
1.01	9.10	55	.05	.03	.02	84.
1.01	9.20	56	.05	.03	.02	100.
1.01	9.30	57	.05	.03	.02	117.
1.01	9.40	58	.05	.03	.02	135.
1.01	9.50	59	.05	.03	.02	153.
1.01	10.00	60	.05	.03	.02	172.
1.01	10.10	61	.05	.03	.02	191.
1.01	10.20	62	.05	.03	.02	210.
1.01	10.30	63	.05	.03	.02	229.
1.01	10.40	64	.05	.03	.02	247.
1.01	10.50	65	.05	.03	.02	264.
1.01	11.00	66	.05	.03	.02	281.
1.01	11.10	67	.05	.03	.02	298.
1.01	11.20	68	.05	.03	.02	314.
1.01	11.30	69	.05	.03	.02	329.
1.01	11.40	70	.05	.03	.02	344.
1.01	11.50	71	.05	.03	.02	359.
1.01	12.00	72	.05	.03	.02	373.
1.01	12.10	73	.34	.33	.02	389.
1.01	12.20	74	.34	.33	.02	409.
1.01	12.30	75	.34	.33	.02	436.



MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.02	1.10	151	0.00	0.00	0.00	3661.
1.02	1.20	152	0.00	0.00	0.00	3560.
1.02	1.30	153	0.00	0.00	0.00	3461.
1.02	1.40	154	0.00	0.00	0.00	3364.
1.02	1.50	155	0.00	0.00	0.00	3270.
1.02	2.00	156	0.00	0.00	0.00	3178.
1.02	2.10	157	0.00	0.00	0.00	3088.
1.02	2.20	158	0.00	0.00	0.00	3000.
1.02	2.30	159	0.00	0.00	0.00	2914.
1.02	2.40	160	0.00	0.00	0.00	2830.
1.02	2.50	161	0.00	0.00	0.00	2748.
1.02	3.00	162	0.00	0.00	0.00	2668.
1.02	3.10	163	0.00	0.00	0.00	2591.
1.02	3.20	164	0.00	0.00	0.00	2515.
1.02	3.30	165	0.00	0.00	0.00	2442.
1.02	3.40	166	0.00	0.00	0.00	2371.
1.02	3.50	167	0.00	0.00	0.00	2302.
1.02	4.00	168	0.00	0.00	0.00	2234.
1.02	4.10	169	0.00	0.00	0.00	2169.
1.02	4.20	170	0.00	0.00	0.00	2106.
1.02	4.30	171	0.00	0.00	0.00	2044.
1.02	4.40	172	0.00	0.00	0.00	1984.
1.02	4.50	173	0.00	0.00	0.00	1911.
1.02	5.00	174	0.00	0.00	0.00	1839.
1.02	5.10	175	0.00	0.00	0.00	1770.
1.02	5.20	176	0.00	0.00	0.00	1703.
1.02	5.30	177	0.00	0.00	0.00	1638.
1.02	5.40	178	0.00	0.00	0.00	1574.
1.02	5.50	179	0.00	0.00	0.00	1509.
1.02	6.00	180	0.00	0.00	0.00	1445.
1.02	6.10	181	0.00	0.00	0.00	1384.
1.02	6.20	182	0.00	0.00	0.00	1324.
1.02	6.30	183	0.00	0.00	0.00	1266.
1.02	6.40	184	0.00	0.00	0.00	1209.
1.02	6.50	185	0.00	0.00	0.00	1149.
1.02	7.00	186	0.00	0.00	0.00	1091.
1.02	7.10	187	0.00	0.00	0.00	1034.
1.02	7.20	188	0.00	0.00	0.00	979.
1.02	7.30	189	0.00	0.00	0.00	925.
1.02	7.40	190	0.00	0.00	0.00	873.
1.02	7.50	191	0.00	0.00	0.00	825.
1.02	8.00	192	0.00	0.00	0.00	781.
1.02	8.10	193	0.00	0.00	0.00	667.
1.02	8.20	194	0.00	0.00	0.00	467.
1.02	8.30	195	0.00	0.00	0.00	429.
1.02	8.40	196	0.00	0.00	0.00	400.
1.02	8.50	197	0.00	0.00	0.00	373.
1.02	9.00	198	0.00	0.00	0.00	348.
1.02	9.10	199	0.00	0.00	0.00	325.
1.02	9.20	200	0.00	0.00	0.00	303.
1.02	9.30	201	0.00	0.00	0.00	283.
1.02	9.40	202	0.00	0.00	0.00	264.
1.02	9.50	203	0.00	0.00	0.00	246.
1.02	10.00	204	0.00	0.00	0.00	230.
1.02	10.10	205	0.00	0.00	0.00	214.
1.02	10.20	206	0.00	0.00	0.00	200.
1.02	10.30	207	0.00	0.00	0.00	187.
1.02	10.40	208	0.00	0.00	0.00	174.
1.02	10.50	209	0.00	0.00	0.00	163.
1.02	11.00	210	0.00	0.00	0.00	152.
1.02	11.10	211	0.00	0.00	0.00	142.
1.02	11.20	212	0.00	0.00	0.00	132.
1.02	11.30	213	0.00	0.00	0.00	123.
1.02	11.40	214	0.00	0.00	0.00	115.
1.02	11.50	215	0.00	0.00	0.00	107.
1.02	12.00	216	0.00	0.00	0.00	100.
1.02	12.10	217	0.00	0.00	0.00	93.
1.02	12.20	218	0.00	0.00	0.00	87.
1.02	12.30	219	0.00	0.00	0.00	81.
1.02	12.40	220	0.00	0.00	0.00	76.
1.02	12.50	221	0.00	0.00	0.00	71.
1.02	13.00	222	0.00	0.00	0.00	66.
1.02	13.10	223	0.00	0.00	0.00	62.
1.02	13.20	224	0.00	0.00	0.00	57.
1.02	13.30	225	0.00	0.00	0.00	54.

1.02	13.40	226	0.00	0.00	0.00	50.
1.02	13.50	227	0.00	0.00	0.00	47.
1.02	14.00	228	0.00	0.00	0.00	44.
1.02	14.10	229	0.00	0.00	0.00	41.
1.02	14.20	230	0.00	0.00	0.00	38.
1.02	14.30	231	0.00	0.00	0.00	35.
1.02	14.40	232	0.00	0.00	0.00	33.
1.02	14.50	233	0.00	0.00	0.00	31.
1.02	15.00	234	0.00	0.00	0.00	29.
1.02	15.10	235	0.00	0.00	0.00	27.
1.02	15.20	236	0.00	0.00	0.00	25.
1.02	15.30	237	0.00	0.00	0.00	23.
1.02	15.40	238	0.00	0.00	0.00	22.
1.02	15.50	239	0.00	0.00	0.00	20.
1.02	16.00	240	0.00	0.00	0.00	19.
1.02	16.10	241	0.00	0.00	0.00	18.
1.02	16.20	242	0.00	0.00	0.00	17.
1.02	16.30	243	0.00	0.00	0.00	15.
1.02	16.40	244	0.00	0.00	0.00	14.
1.02	16.50	245	0.00	0.00	0.00	13.
1.02	17.00	246	0.00	0.00	0.00	13.
1.02	17.10	247	0.00	0.00	0.00	12.
1.02	17.20	248	0.00	0.00	0.00	11.
1.02	17.30	249	0.00	0.00	0.00	10.
1.02	17.40	250	0.00	0.00	0.00	9.
1.02	17.50	251	0.00	0.00	0.00	9.
1.02	18.00	252	0.00	0.00	0.00	8.
1.02	18.10	253	0.00	0.00	0.00	8.
1.02	18.20	254	0.00	0.00	0.00	7.
1.02	18.30	255	0.00	0.00	0.00	7.
1.02	18.40	256	0.00	0.00	0.00	6.
1.02	18.50	257	0.00	0.00	0.00	6.
1.02	19.00	258	0.00	0.00	0.00	5.
1.02	19.10	259	0.00	0.00	0.00	5.
1.02	19.20	260	0.00	0.00	0.00	5.
1.02	19.30	261	0.00	0.00	0.00	4.
1.02	19.40	262	0.00	0.00	0.00	4.
1.02	19.50	263	0.00	0.00	0.00	4.
1.02	20.00	264	0.00	0.00	0.00	4.
1.02	20.10	265	0.00	0.00	0.00	3.
1.02	20.20	266	0.00	0.00	0.00	3.
1.02	20.30	267	0.00	0.00	0.00	3.
1.02	20.40	268	0.00	0.00	0.00	3.
1.02	20.50	269	0.00	0.00	0.00	3.
1.02	21.00	270	0.00	0.00	0.00	2.
1.02	21.10	271	0.00	0.00	0.00	2.
1.02	21.20	272	0.00	0.00	0.00	2.
1.02	21.30	273	0.00	0.00	0.00	2.
1.02	21.40	274	0.00	0.00	0.00	2.
1.02	21.50	275	0.00	0.00	0.00	2.
1.02	22.00	276	0.00	0.00	0.00	1.
1.02	22.10	277	0.00	0.00	0.00	1.
1.02	22.20	278	0.00	0.00	0.00	1.
1.02	22.30	279	0.00	0.00	0.00	1.
1.02	22.40	280	0.00	0.00	0.00	1.
1.02	22.50	281	0.00	0.00	0.00	1.
1.02	23.00	282	0.00	0.00	0.00	1.
1.02	23.10	283	0.00	0.00	0.00	1.
1.02	23.20	284	0.00	0.00	0.00	1.
1.02	23.30	285	0.00	0.00	0.00	1.
1.02	23.40	286	0.00	0.00	0.00	1.
1.02	23.50	287	0.00	0.00	0.00	1.
1.03	0.00	288	0.00	0.00	0.00	1.
1.03	.10	289	0.00	0.00	0.00	1.
1.03	.20	290	0.00	0.00	0.00	1.
1.03	.30	291	0.00	0.00	0.00	1.
1.03	.40	292	0.00	0.00	0.00	1.
1.03	.50	293	0.00	0.00	0.00	1.
1.03	1.00	294	0.00	0.00	0.00	0.
1.03	1.10	295	0.00	0.00	0.00	0.
1.03	1.20	296	0.00	0.00	0.00	0.
1.03	1.30	297	0.00	0.00	0.00	0.
1.03	1.40	298	0.00	0.00	0.00	0.
1.03	1.50	299	0.00	0.00	0.00	0.
1.03	2.00	300	0.00	0.00	0.00	0.

HYDROGRAPH AT STA LAKE FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4529.	3798.	1698.	822.	246674.
CMS	128.	108.	48.	23.	6985.
INCHES		5.52	9.87	9.96	9.96
MM		140.23	250.77	252.97	252.97
AC-FT		1883.	3368.	3398.	3398.
THOUS CU M		2323.	4155.	4191.	4191.

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HYDROGRAPH ROUTING

ROUTED DISCHARGE THROUGH CAMPBELL DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-214.	-1

STAGE	214.00	215.00	216.00	217.00	218.00	219.00	220.00	221.00	222.00
FLOW	0.00	392.70	1110.70	2040.50	3141.60	4435.60	5980.00	7070.60	8145.70
SURFACE AREA=	0.	5.	18.	36.	62.				
CAPACITY=	0.	21.	86.	618.	1588.				
ELEVATION=	208.	214.	220.	240.	260.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
214.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

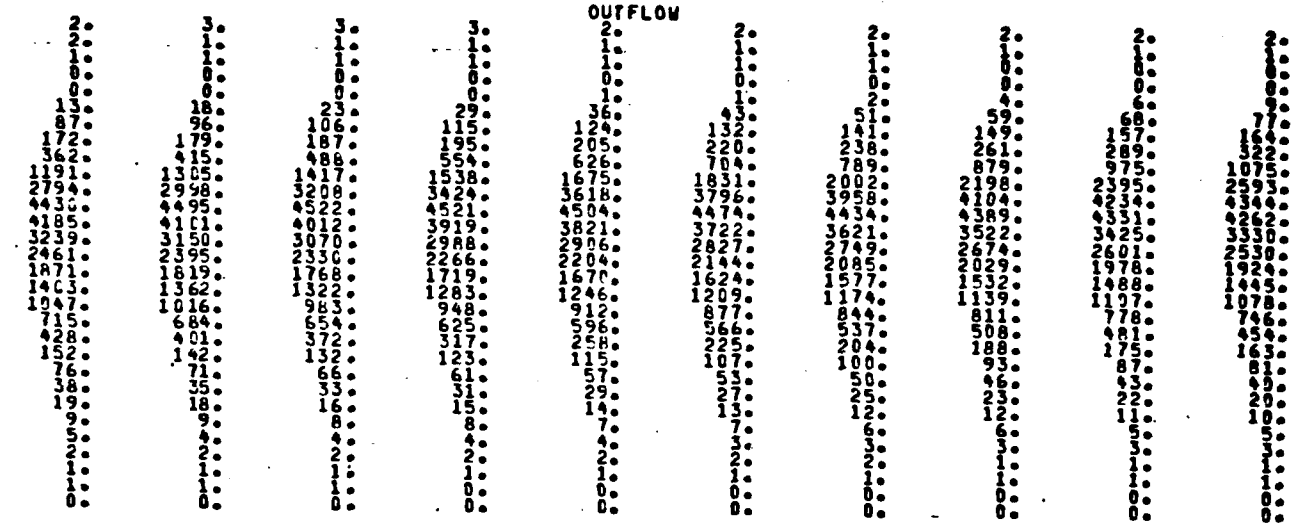
DAM DATA

TOPEL	COQD	EXPD	DAMWID
222.0	2.6	1.5	245.

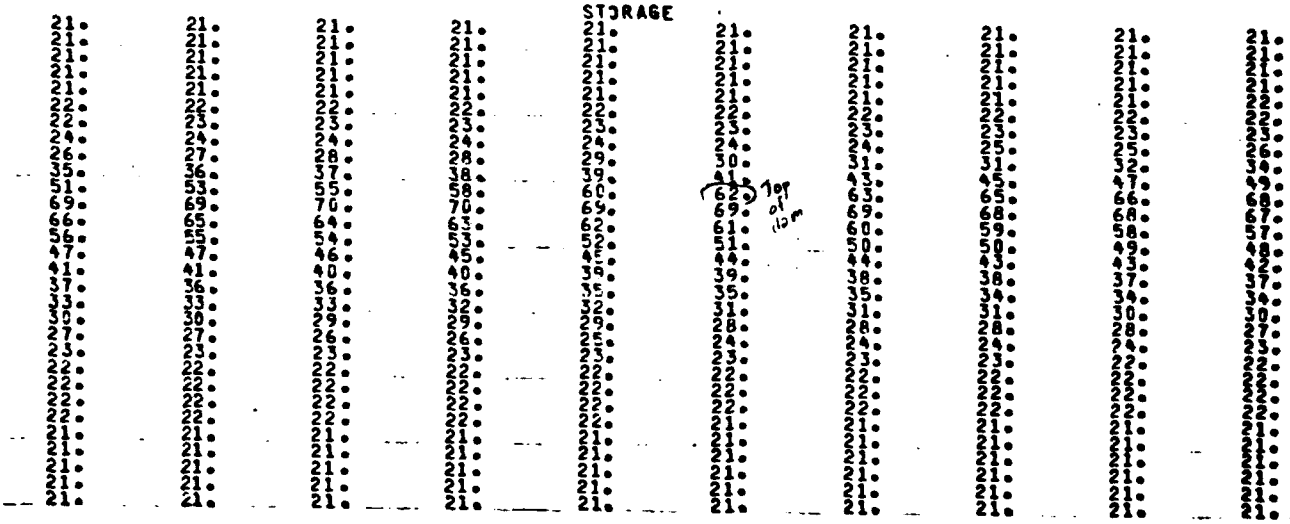
STATION DAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

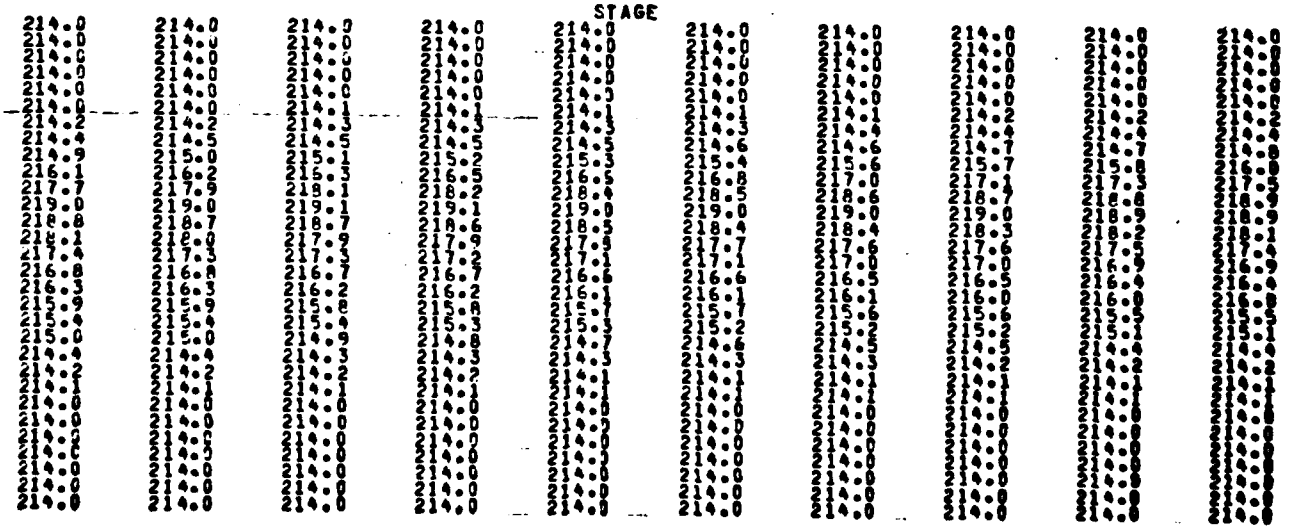
OUTFLOW



STORAGE



STAGE



SUMMARY OF DAM SAFETY ANALYSIS

1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	214.00	214.00	222.00
STORAGE	21.	21.	124.
OUTFLOW	0.	0.	8146.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	219.66	0.00	70.	4522.	0.00	18.83	0.00
.40	218.37	0.00	60.	3617.	0.00	19.00	0.00
.30	217.01	0.00	50.	2713.	0.00	19.00	0.00
.20	215.75	0.00	41.	1808.	0.00	19.00	0.00
.10	215.71	0.00	32.	904.	0.00	19.00	0.00

APPENDIX 5

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